PROCEEDINGS

Eighty-Fifth Annual Conference

OF THE

American Railway Bridge & Building Association

1980

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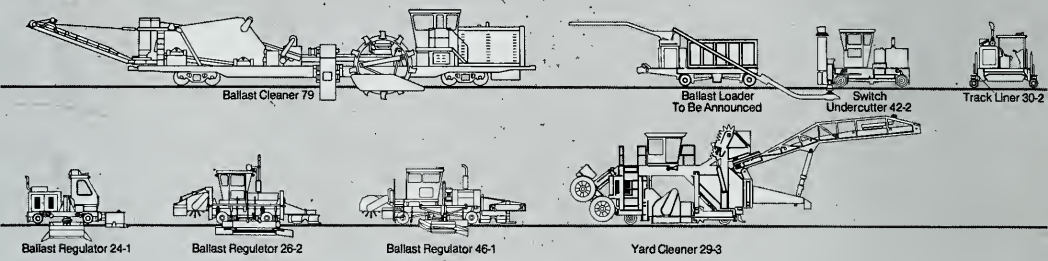

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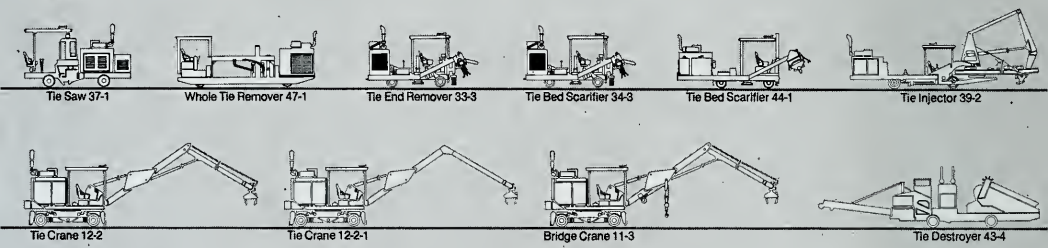

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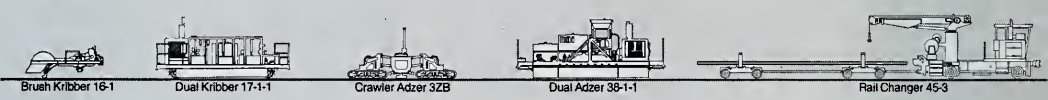

Right-Of-Way Vegetation Control

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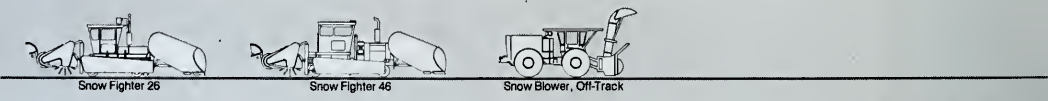

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Arthur Kill Bridge Staten Island, N. Y.	1959
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Turtle River Bridge Brunswick, Ga.	1956
South Park Avenue Bridge Buffalo, N. Y.	1955
McNary Dam—Navigational Lock Bridge, Columbia River	1950
North State Street Bridge Chicago, Ill.	1949
The Canal Street Bridge Chicago, Ill.	1948
San Joaquin River Bridge Mossdale, Calif.	1948
The Commodore Schuyler F. Helm Bridge, Los Angeles, Calif.	1947
Lake Washington Floating Bridge Seattle, Wash.	1940
Lewiston-Clarkston Bridge Washington-Idaho Border	1939
Torrence Avenue Bridge Chicago, Ill.	1936
Cape Cod Canal Bridge Buzzards Bay, Mass.	1935

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Proceedings of the

Eighty-Fifth Annual Conference

of the

American Railway Bridge & Building Association

Held at

CHICAGO, ILLINOIS

September 15-17, 1980

Published by the Association

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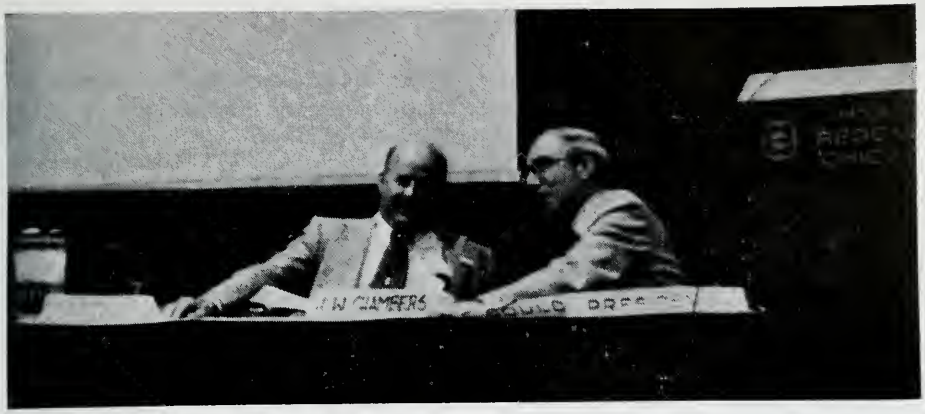

Informal passing of the gavel.

PROCEEDINGS

REGISTRATION totaled 789 railroaders and 124 ladies.

September 15, 1980

The first Joint Session of the Roadmasters' and Maintenance of Way Association and American Railway Bridge & Building Association's Technical Conference for 1980 was called to order at the Hyatt Regency-Chicago Hotel, Chicago, Illinois, Monday morning, September 15, 1980, at 9:00 A.M., Mr. D. C. Gould, President of the Bridge and Building Association, presiding.

President Gould: It is nine o'clock and we have a full day ahead of us. We will call this meeting to order.

Any Bridge & Building people or Roadmasters out in the hall, please, come in and encourage the others to come in.

As President of the American Railway Bridge & Building Association, and, on behalf of Mr. Gale, President of the Roadmasters and Maintenance of Way Association of America, I declare this, the 85th Annual Conference of the American Railway Bridge & Building Association and the 92nd Annual Conference of the Roadmasters and Maintenance of Way Association of America to be open in joint session.

It is proper that we pause to ask for divine guidance and inspiration prior to commencing our Conference. I would like to introduce the Reverend Le Roy Cronkhite II, Pastor, Central Church of Chicago, who will deliver the Invocation. Reverend Cronkhite.

Reverend Cronkhite: Please stand for Prayer.

Let us pray. O Lord God, we come to you this morning to mark the beginning of this conference, renewing fellowship, seeking to obtain certain objectives, and look back on a year in which so much has happened that it is hard to recount it all. Yet, in the midst of so many experiences we are reminded that no one ever said it would be easy, but, dear Lord, must it be this difficult?

We seek Your Presence throughout this conference, that these who have united in this conference may find in it directions that need to be taken. That Your Guidance will lead them in all that they do and that they shall depart from this time and place feeling that this has been worthwhile and good and life must move on and out.

Guide and direct and lead each one through this meeting. For this, we pray. Amen.

President Gould: Thank you, Reverend Cronkhite for those words of inspiration. You will be welcome to remain through this session.

I join with President Gale in welcoming you to the first Joint Session of the two Associations. We sincerely hope you will enjoy your visit to Chicago and urge you to attend the sessions of this two and one-half day conference.

Please read your program through carefully as it is full of excellent topics. Enjoy yourselves and partake of the hospitality extended by REMSA.

For the ladies, we have an interesting program starting today, with coffee and rolls during registration in the Hong Kong Room and a demonstration this afternoon in the Watertower Room.

Tomorrow the ladies will visit the Art Institute, lunch at Como Inn and tour the Antique Warehouse.

I would like to introduce the Officers and Directors of the Railway Bridge & Building Association who are seated at the head table.

Those whose duties demand their presence elsewhere will be introduced at tomorrow's session.

Your Officers are doing an excellent job of directing our Association and they and their counterparts in the Roadmasters Association have put together another great Conference program.

As I introduce each person, I ask that he stand and remain standing until all have been introduced. Please, hold your applause until all have been introduced.

Starting at my far left, Mr. W. C. Sturm, Immediate Past President, Senior Product Engineer, E. J. & E., Joliet, Illinois.

Mr. O. C. Denz, Director, Supervisor of Buildings and Maintenance, Milwaukee Road, Chicago.

Mr. W. S. Stokely, Director, Roadway Engineer, ICG, Chicago.

Mr. J. W. Davidson, Director, Assistant Director of Bridge Engineering, BN, St. Paul.

Mr. W. F. Armstrong, Treasurer, Engineer of Buildings, C&NW, Chicago.

Mr. W. R. Hyma, Junior Vice President, Bridge Engineer of System, AT& SF, Chicago.

R. C. McMaster, Junior Vice President, Manager of Facilities & Structures, B&LE, Greenville, Pennsylvania.

Mr. J. W. Chambers, Senior Vice President, Bridge Construction Engineer, MP, St. Louis.

You may now applaud. (Applause)

President Gale, I now turn the Conference over to you.

President Gale: Thank you, President Gould. I join President Gould in welcoming you to this Joint Session of our two Associations. We sincerely hope that your business in Chicago will be rewarding and enjoyable. The Committees of these two Associations have worked hard in supplying the various presentations of this Conference. I am sure they will be of benefit to you and your railroads.

I would like you to meet the Officers of the Roadmasters' Association who have ably guided this Association during the past year.

Will you please stand and remain standing until all have been introduced? Please hold your applause until all have been introduced. At my extreme right, Mr. C. E. Barton, District Engineer, Missouri Pacific Railroad, N. Little Rock, Arkansas.

Mr. H. C. Lewandowski, Director, General Roadmaster, Chicago, Milwaukee, St. Paul & Pacific, Chicago, Illinois.

Mr. H. V. Meek, Director, General Roadmaster, Denver & Rio Grand Western, Grand Junction, Colorado.

Mr. B. H. (Bud) Price, Sr., Director, Development Engineer, Bessemer & Lake Erie Railroad, Greenville, Pennsylvania.

Mr. H. B. Harris, Director, Roadmas-

ter, Seaboard Coast Line, Hamlet, North Carolina.

Mr. H. M. Hamilton, Director, Engineer, Maintenance of Way, Algoma Central, Sault Ste. Marie, Canada.

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First Vice President, B. D. Sorrels, District Engineer, Atchison, Topeka & Santa Fe Railroad, Amarillo, Texas.

You may now applaud. (Applause)

I would also like to introduce the gentleman on my right, Mr. Mike Rougas, President, American Railway Engineering Association. Mr. Rougas is Chief Engineer of the Bessemer & Lake Erie Railroad, Greenville, Pennsylvania. Mr. Rougas. (Applause)

Mr. Rougas: Thank you, President Gale. Good morning, ladies and gentlemen.

To all of you I bring greetings from the Board of Direction of AREA. I am gratified, in looking at both programs for your Conference and am certain that you will have a successful Conference.

I can also say that the subjects also depict work which goes hand-in-hand with that of AREA.

You might like to know that the thrust of the administrative work of AREA at the present time is oriented primarily at meeting with interested persons with FRA in Washington in an effort to help make more realistic FRA's desire to promulgate additional rules to govern some of the activities which you supervise.

Recently, FRA made a very serious study to determine where they should promulgate rules which would govern the inspection of bridges, the maintenance of railroad bridges and, possibly, the rating of railroad bridges. Last July we were given the opportunity to go to Washington to make a presentation to them in an effort to show them that the cause of railroad safety would not be enhanced by promulgating additional rules to cover these activities. I am not certain if we have been successful, although I am hopeful that we have.

In any case, I would like to emphasize to you that when it comes to the subject of railway safety, we are not apart. Our goals with those of FRA are identical. If you believe that promulgating additional rules will not enhance railway safety, I do urge you to continue to work like you have in the past to keep the trains on the track, and not have any bridge failures. That is the best and surest way not to have additional regulations.

Again, I wish you a successful conference. I would like to conclude by inviting those of you who can to attend the upcoming regional AREA meeting in Los Angeles on October 23. Thank you. (Applause)

President Gale: Thank you, Mr. Rougas.

The other gentleman next to Mr. Rougas will be introduced to you later.

I now turn the rostrum back to you, President Gould.

President Gould: Everyone is allowed one mistake. I have had two of them this morning. A gentleman whom I missed in my introductions, is Mr. J. N. Michel, a Director, Manager, Engineering Design, AMTRAK, Washington, D.C. I am very sorry, Jim. (Applause)

The Railway Engineering Maintenance Suppliers Association, is this year, as they have in the past, greeting this Conference with their hospitality and assistance. It is my pleasure to introduce the President of REMSA, Mr. Owen Buscho, District Sales Manager, Fairmont Railway Motors. Mr. Buscho.

Mr. Buscho: Presidents Gale and Gould, ladies and gentlemen, it is indeed an honor for me, as President of REMSA, to be asked to join in welcoming you to the 92nd Annual Conference of the Roadmasters Association and the 85th Conference of the Bridge & Building Association. The longevity and the impact of these two groups is certainly

noteworthy in the association field and I know that all members of REMSA join me in wishing you a very successful and productive 1980 meeting.

At this time I would like to present to Don Gale REMSA's gold pin, which reads: "President — Roadmasters and Maintenance of Way Association of America, 1979-1980." Don.

Also, to Don Gould, I would like to present on behalf of our membership a matching pin, which reads: "President—American Railway Bridge & Building Association—1979-1980." Don. (Applause)

We hope that your stay in Chicago will be pleasant. The Officers and Directors of REMSA are at your call. If we can do anything to make your stay more enjoyable and problem free, please do not hesitate to call upon us.

We know that many of you are looking forward to the Annual Banquet on Tuesday in the Regency Ballroom. You will hear more about the entertainment shortly. Thank you very much. (Applause)

President Gould: Will the gentlemen and Officers at the head table now take seats down on the floor for the next presentation? I know you will be able to see better and enjoy it more.

Oh, I am sorry. Just a moment. Will you please return? I am very sorry. I missed Mr. Cal Coy of REMSA.

Mr. Coy: I almost missed my chance to speak!

Presidents Gale and Gould, and special guests, ladies and gentlemen:

Once again REMSA is pleased to hold its Annual Banquet for the Roadmasters and Bridge & Building Associations. It will be held in the Regency Ballroom tomorrow night, September 16th. The doors will be open at 6:30. Dinner will be served at 7:00 P.M.

A musical trio will greet you at the door, followed by dinner and a fast pace program.

Benny Sharp, an old friend of the railroads, will again be in charge of the entertainment, featuring Spink Freeman, an impressionist and comedian, as headliner, and Allan and Diana, an outstanding singing team, with songs from musical comedies and current recordings. Benny will lead the Sharp Band and I am sure you will enjoy the show.

We hope this event can be concluded in time to permit all of you to spend some time Tuesday evening visiting with your friends and suppliers.

The same ticket arrangement will prevail as it has for the many years that REMSA has had the privilege of being host for this joint meeting. All registered railroad men and their wives will be provided with complimentary tickets. I sincerely hope that all of you can join us. Thank you. (Applause)

President Gould: Now will the gentlemen at the head table please join the people in the audience for the next presentation?

While they are moving down, one gentleman in the audience, who is largely responsible for me being up here this morning, I would like to mention. He is Past President of the AREA. He has the distinction of being named "Man Of The Year." And is the Chief Engineer of the Union Pacific Railroad. He is my boss and President Don Gale's boss, Mr. Robert M. Brown. Will you please stand to be recognized? (Applause)

I would like to present Mr. Robert L. Richmond, Vice President, Operations, Union Pacific Railroad, who will bring the keynote address.

Mr. Richmond was born in Sheridan, Wyoming. He joined the Union Pacific as a Student Telegrapher in Idaho in 1927. Mr. Richmond moved up through various positions, in 1963 was appointed Assistant Superintendent of the Utah Division in Salt Lake City, and advanced to Superintendent in 1968. A year later he was promoted to General Superintendent of the Northwest District, with offices in Portland, Oregon.

Mr. Richmond came to Omaha in 1971 as Assistant to the Vice-President of Operations.

In 1972, he returned to Salt Lake as General Manager for the South Central District.

Mr. Richmond returned to Omaha in

1974 as Assistant Vice-President of Operations in 1977, which position he holds today.

I have the high privilege and distinct honor to present Mr. Robert L. Richmond. (Applause)

Keynote Address

By R. L. RICHMOND

Vice-President - Operations, Union Pacific, Omaha, Neb.

Thank you very much, President Gould.

You know, it is always somewhat of a shock to stand up to start talking and to see everyone leave the head table. But I think after we get into the program you may realize why that is necessary.

I am very pleased, of course, to be here today to talk to you folk as an operating officer. I suppose I am in about as good a position as anyone to appreciate the work you and your people do. I am a firm believer that much of the railroad's best work is done by people in the Engineering and Maintenance of Way Departments. In looking around here today, I just cannot help but wonder who is doing the work today.

R. L. Richmond

Money Spent on Maintenance Well Spent

At Union Pacific we are very, very proud of our Engineering Department and the job that it does. I am sure that probably holds true with every railroad represented here today. We feel that a dollar spent on the maintenance of way is usually a dollar that is very well spent, indeed.

The railroads have served America well in the past and, of course, one of the reasons for that service was based on the solid foundation of the industry's physical plants. I might say that the future lies there as well.

The condition of the railroad industry's tracks, bridges and buildings has an important effect on how well our industry continues to serve our country.

Railroads Play Important Role In Energy and Economy

From an energy standpoint, alone, the railroads simply must continue to play an ever-growing part in the better use of the nation's resources. That, in turn, means that you will continue to play an important part in the country's future. You know, many of us become so wrapped up in our own affairs that

we sometimes fail to take time to occasionally step back and get a fresh, new look at our own activities. This is especially true in the areas that require special technology, tools and treatment. Railway maintenance of way is in such an area. We become so involved with the details of a given project that the final goal of that project, namely, assistance in the safe and final delivery of a customer's goods, is lost in the schedule.

I hope most of you, once in a while, will have that opportunity to step back and examine what you do and why, and how it affects everyone else in the organization.

For example, the safety of the train and crews is directly dependent upon you and the quality of your work. Without your care and attention, the quality of their work suffers, also. I wonder if you have ever thought how what you do affects the Traffic Department?

A salesman would much prefer to be out drumming up new business than handling complaints because of the late arrival of a shipment. Again, your work directly affects the customer satisfaction and whether or not he or she has something about which to complain.

I could stand here for some time and continue to cite additional side effects of maintenance of way on our various company's performance, but the lesson would still be the same. No part of the organization is truly independent of the rest. However, it is sometimes wise and necessary to look to see how it all fits together.

Railroads' Most Important Resource: Its People

I believe that after about one hundred fifty years the railroad industry is becoming conservatively more what I would refer to as "humanized." It used to be that we spent so much time talking about tracks and locomotives, bridges and cars, computers, buildings and so forth, that we often did not spend much time talking about our most important resource, our people.

For many people, a company, or a department, for that matter, had its own identity, without any reference at all to the people who work there. When I think about this I never fail to be surprised. I guess it was just a blind spot in management that we overlooked.

It should be clear that no corporation nor department of any size exists other than by the means of its people. A business is nothing more than a group of people who have come together and armed themselves with the necessary tools to produce a product or service for other people. This is exactly the case of the Union Pacific.

Admittedly, we came together quite a few years ago, as did most of your companies. We have tried to sell a considerable amount of stock in order to arm ourselves with the necessary tools—9,500 miles of railroad track for starters, and about 27,000 people strong, which makes us not the smallest, and, so far, not the largest railroad. But it does provide us with 27,000 opportunities to produce a better mousetrap, or, on the other hand, 27,000 opportunities to goof.

All of our hardware, as important as it is, is only incidental to the success of our endeavors. We used to have an advertisement that said, "Anyone can buy a box car. It is what the people do with that box car that really counts."

Of course, the same thing is true with the maintenance of way equipment, ballast, bridges, rail, and so forth.

However, as people engaged in the maintenance of way activities, I am not telling you anything new. Perhaps more than anyone else in the railroad industry, you appreciate the work of a good employee. Well, we here at the Union Pacific Railroad have 27,000 good employees. With that, we would like to have our people tell you their story.

So, now, Ralph, if you will, please, we will tell you about the small but sincere Union Pacific Railroad. Thank you. (Applause)

(Presented movie) (Applause)

President Gould: Thank you very much, Mr. Richmond. That was a won-

derful presentation. Thank you and the Union Pacific Railroad.

Our next speaker will be introduced by Mr. Joe Chambers, and here he is. All right, Mr. Chambers, I will turn it over to you.

Mr. Chambers: Gentlemen, the next subject is an address on "Reinforced Earth." The Reinforced Earth Company provides design and engineering services to structure materials and technical assistance during construction for reinforced earth structures in the United States.

Mr. Brad Purinton, the Chicago based Midwest Regional Manager of the Company, is a retired Navy Civil Engineer, a Corps Commander, a graduate of the United States Naval Academy, and Rensselaer Polytechnic Institute.

He is a Registered Professional Engineer. Mr. Purinton. (Applause)

Reinforced Earth

By BRAD PURINTON

Midwest Regional Manager, The Reinforced Earth Company

You know the expression, "A tough act to follow." I do not think I have ever followed such a tough act before.

As Mr. Richmond said, we cannot lose sight of the big picture. I am afraid we are going to go from a big picture to a very small one right now. Instead of talking about the overview of railroading, we will be talking about one very small tool that may be useful to you in your maintenance, construction and repair programs. We have a single slide projector, only one screen and no music, and, if the man is ready to run the projector, we will go ahead.

I understand we have to wait a minute while the house man comes over to set up the single projector.

I think we are all slaves to gadgetry of one sort or another. This reminds me of that expression that you always want to get your presentation off to a smooth and professional start. That then reminds me of the idea that the first thing you should do when you get up in the morning is eat a live frog. Then everything that happens the balance of the day will seem good by comparison.

I am really pleased to describe for

Brad Purinton

you the current state of the art for the Reinforced Earth concept. Two years ago, Victor Elias, our Vice President of Engineering, described for this meeting a new concept for the construction of steep-faced earth embankments and all their various and familiar forms, retain-

ing walls, bridge abutments and so forth. Mr. Elias spoke of railroad application systems in Europe, of highway and industrial applications in this country and railroad projects under study.

What Reinforced Earth Is

Well, we have come a long way in two years and, this morning, I would like to update you on the development of this period and perhaps leave you some ideas on how the concept may be of use to you.

For those of you who may not be familiar with Reinforced Earth, a very brief description of the concept may be in order.

Reinforced Earth is a construction material formed by the association of cohesionless soils and linear metallic reinforcements, which, together, form an integral structure.

The Reinforced Earth concept is analogous to that of reinforced concrete. One material adds substantial strength to another.

This first slide gives us a typical section of a reinforced earth retaining wall. The concrete facing is on the left and the galvanized steel reinforcing strips extend through the Reinforced Earth volume made up of a select specified granular fill.

The horizontal forces that exist in any embankment are taken in tension by the steel. As I said a minute ago, it is similar to the design of reinforced concrete structures.

The structure constructed of this material acts as a coherent gravity mass flexible enough to accommodate differential settlement and yet is able to distribute base loads evenly without loss of structural effectiveness.

The Reinforced Earth construction sequence is basically that of an embankment construction with a few added steps. In the construction process the crew begins by forming and pouring an unreinforced concrete leveling pad.

The first row of pre-cast reinforced concrete panels is placed on this leveling pad and braced. Galvanized steel reinforcing strips are bolted in place. This slide gives us a schematic idea of how the different pieces fit together.

Here is the real thing.

It is bolted to tabs cast in the back of the panels. The granular select fill is placed and compacted in 8-inch lifts.

Compaction along the back side of the wall is done with light equipment simply to avoid the chance of a heavy piece of equipment hitting the wall.

This procedure is repeated with additional rolls of panels and reinforcing strips and fill.

The horizontal joints between the panels are filled with a compressed core gasket to be sure that the finished wall base is flexible. The vertical joints are filled with a polyfoam filter material, which allows the volume to drain without having fines migrate out of the fill.

Templets are used to insure the alignment of the panels to the wall as it goes up.

Panels are placed with a light crane.

The lines are plumb. Notice the wooden clamps that are used to hold the panels in place after the first row is in position.

Only the bottom row or row and one-half is supported by bracing, an important factor for the superintendent in the field.

Since the earliest days of Reinforced Earth in this country, the emphasis has been on the theory of the design and on the study of the behavior of actual structures to verify the adequacy of the design procedures being used. The chart shows a series of instrumentation studies on actual volumes to determine the actual stress distribution in the steel reinforcing.

Reinforced Earth Fast and Economical

Most of you in your daily work, however, face not design problems but operational problems. You are less concerned with elegant design solutions than with practical efficient operational answers. Similarly, my background is construction and maintenance and it is

from this point of view that I would like to discuss the application of Reinforced Earth today.

Simply stated, this material permits the rapid economical construction of stable steep-face earth embankment. Consider it simply one more tool in your bag of maintenance and construction tricks, just as you would a new piece of construction equipment.

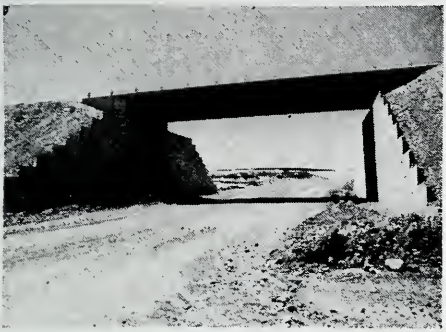


FIGURE 1

Typical Reinforced Earth walls on rural overpass.

The applications are limited only by your imagination, by practical consideration and by economics, which, is to say, the obvious. Under some circumstances it may be the best, or, the only practical solution. At times it is the most economically feasible solution. Sometimes it will not be appropriate and sometimes a cheaper way may be found to do the job.

Important Factors

A number of factors are inherent in the Reinforced Earth concept that are important to the supervisor who is responsible for a construction project in the field, which apply regardless of specific applications. First, the system is simple to construct. A crew with no previous Reinforced Earth experience learns the sequence quickly. Of course, the Reinforced Earth Company provides technical assistance in the field, especially during the start-up period.

Secondly, excepting for the equipment operators, the crew does not require highly skilled workers, in contrast to a formed and cast structure, for example, with complex form work and reinforcing steel work. Depending on the specific union situation, this could have an important impact on your labor cost. The system is ideal for construction by an in-house work force.

Third, it is less weather sensitive than most construction processes.

Fourth, the material can be stockpiled in advance. Of course, each job requires individual design and calculations. However, in an emergency this can be done very quickly.

Similarly, components for a spring construction start-up of a large job may be fabricated and pre-cast during cold weather.

Fifth, elaborate or specialized equipment is not required for construction. Equipment for transporting, placing and compacting the fill, and a light crane to handle the panels is all that are needed. These are obviously available anywhere. All materials can be easily transported to the site by rail.

And, finally, and, perhaps most important to the supervisor in the field, the sequence of the work is extremely flexible. At any point during construction, the exposed layer of reinforcing strips is placed and bolted in a corresponding lift of fill which is placed and compacted. The structure is stable and safe. Thus, it is practical and safe to place the Reinforced Earth work to suit operational needs and other construction requirements. This is a very different situation from forming for a cast-in-place concrete structure, for example.

Places To Be Used

Let me give you an idea of some of the applications where you might want to consider the feasibility of Reinforced Earth.

Bridge abutments. The bridge seat itself can be supported by the Reinforced Earth volume, as shown in this slide.

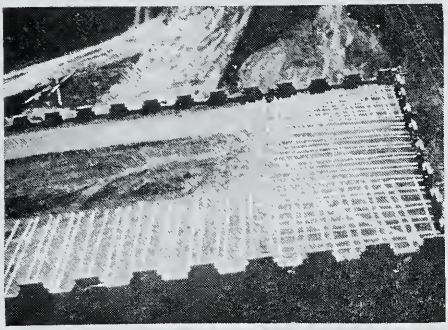


FIGURE 2
Reinforcing strip layout in bridge abutment.

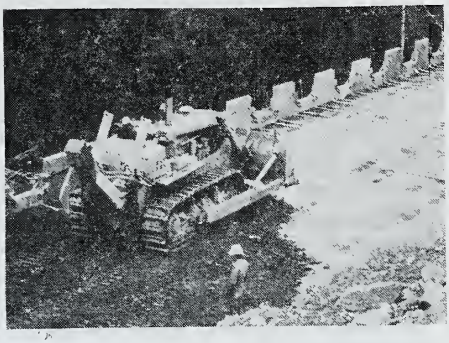


FIGURE 3

Spreading fill over layer of reinforcing strips.

Or the bridge can be supported on piling with the Reinforced Earth system providing the appropriate approach walls, in effect, being a curtain wall.

This series of slides show a sequence of this sort of construction, where the "H" piles are driven before the construction of the retaining wall starts and the reinforcing strips are woven between the pilings. We will get back to this concept in just a few minutes.

Here the curtain wall is going up. The bridge seat is in place and the girders have been put in place.

The cost advantages of Reinforced Earth, which, of course, is one of the things that is most attractive to all our clients, becomes particularly apparent as the wall height increases.

Temporary structures. This little bridge, which has to win the award for the ugliest bridge in town, was built right outside of Washington. It is a temporary structure that will carry the traffic while the permanent bridge is being renovated. These approaches are quick to build, easy to remove, and almost all the material can be salvaged and reused.

Grade separations of almost any sort, and retaining walls to protect it. In this case it is for the support of road lines, highways and access roads.

Reinforced Earth is particularly well suited for use in poor soil conditions. Therefore, if your conventional retaining wall design is pile supported, by all means, you should ask for a Reinforced Earth estimate.

This is on the MARTA system down in Atlanta.

Practical Aspects

Back to the practical aspects. Where rail lines or highways carry a high volume of traffic, any work alongside becomes very difficult and not particularly safe, as you all know so well.

These slides show again how all the work on the Reinforced Earth structure takes place behind the wall. Obviously, here the elevation is such, and, also, the fact that the heavy equipment moves right on top of the fill as soon as it is constructed demonstrates the ability of which I was speaking a few minutes ago.

This slide shows a highway approach over the Springbrook Parkway just outside of New York City. We are currently working on a design for a railroad trestle replacement, using this same general layout. The two faces of concrete panels will be on either side of the trestle. The reinforcing strips will go between the trestle legs. The trestle will remain in service until the last stage of construction and, then, finally, the ties and rails will be removed and the final lift of fill and reinforcing placed. This is very similar to the slide I showed you a few minutes ago where the bridge seat is pile supported. The operational benefits of this short down-time are obvious.

These photos show a slide repair on the Clinchfield Railroad in North Carolina. Some of you may have heard a

paper on this project presented in March of 1980 at the AREA meeting. This is obviously a before program.

This photograph taken from above shows the slide area and the temporary track around it.

This is a section of the design that was developed to prepare this slide. Note that the track is up at the top of the slide and the Reinforced Earth volume that is going to support the fill, supports the track is down at the toe. Appropriate drainage blankets, and so forth, have been incorporated.

This shows the start of the construction of the Reinforced Earth structure. It also shows some timbered cribbing with ballast about half-way up between the temporary track and the toe of the shoe. This was an initial attempt to use cribbing and ballast to repair the line. That attempt was abandoned early on.

The construction sequence goes ahead with the now familiar strips, ballast, and so forth.

And the almost completed structure.

This water front loading structure in Owensboro, Kentucky, has a spur line on the Reinforced Earth volume. This structure has been overtopped during flood stage without any harm. It is a locked backfill and suffered no damage.

Industrial Uses

Industrial uses include truck dumps. This one is at Climax, Colorado, on a mine site, which allows the dumping of ore into the crusher, which will be supported on the casting plates on the structure on the left-hand side. Reinforced Earth structures handle the vibrations associated with this sort of thing without difficulty.

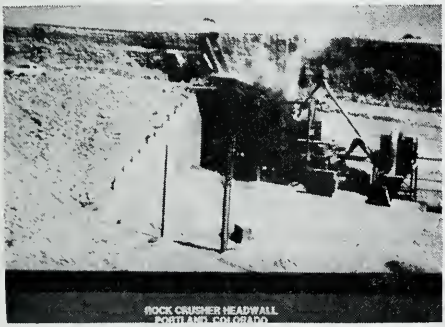


FIGURE 4

Typical industrial application of Reinforced Earth.

A number of temporary truck dumps have been built in the west, which can be used at a site for a year or so, disassembled and the material salvaged and it can be re-erected at another location.

Both material storage and handling facilities, including coal with slots of 100,000 tons capacity, such as this one, was a reclaim tunnel at the bottom, and, of course, conveyors.

This is the site of a completed cold storage handling facility, with the loading tower and the rail lines.

On a smaller scale, here is a settling basin, which is lined with an impervious liner.

We all have problems with runoff and sedimentation, and lagoons, right now, so time may come when something like this is attractive.

These retaining structures and containment bins at the southern terminus of the Alaskan Pipeline at Valdez are designed for extreme seismic loadings, specifically accelerations associated with earthquakes that would register 8.2 on the Richter scale.

Finally, these containment dikes are at a Maryland plant for liquefied natural gas receiving and handling. These facilities are designed not only to contain the gas if the tank was ruptured, but to handle extreme variations in temperature. Here the flexibility of the wall as opposed to a cast-in-place wall, is shown which would shatter under extreme temperature variations.

These existing applications may give you some ideas that apply to your own requirements.

Short Use Repair

I would like to close with one final item for your bag of tricks that may be useful for a short use repair project.

While most reinforced earth structures in this country are faced with con-

crete panels, such as this one, this is 7 inches thick, approximately 5′ by 5′, and weigh about a ton apiece. A number of structures in this country are based on the original French design.

These particular retaining walls are on the Nice-Monte Carlo Expressway. The facing is galvanized sheet steel.

The advantages of the ease of handling of the steel sections at hard-to-work sites and the ease of transport and the ease of storage for pre-positioning are obvious.

Finally, this 15-foot wood faced wall is a test structure recently completed in California. It is faced with 3″ x 12″ treated timbers. The designer was working to produce a rustic appearance wall to use in parks and developments where a particular aesthetic treatment was desired. When I saw the photos, I harkened back to my days in the Sea-Bees and realized what we had here was material that could be manhandled when necessary to reach a difficult site. Of course, compaction of the fill will require compaction equipment but the flexibility to deal with hard-to-watch locations is obvious.

For temporary or emergency purposes, it would seem to me that steel or a wood-faced abutment could be combined with a sectionalized panel bridge or some other sort of prefabricated bridge to give a temporary structure that could be erected very, very quickly.

I hope I have planted a few ideas. When you have an out-of-the-ordinary maintenance or construction problem that you think may fall into one of these categories I have described, give us a call and we will see if we can help you with some sort of reinforcement structure. Thank you very much. (Applause)

President Gale: Thank you very much, Mr. Purinton. Your talk and slides were very informative. In fact, much of the work I had never seen before myself, so I did not know the answers.

Does anybody have any questions? Does anyone have any questions of the gentleman?

Delegate: I noted that the concrete panels are supported by galvanized tie-backs. What type of life expectancy do you get on those? I would think if they would rust you would have a problem.

Mr. Purinton: The real purpose of the concrete panel is to prevent erosion of the face of the fill. The stability, of course, comes from the fact the reinforcing is in them. This is the first question that is always asked.

Much work is going on in Atlanta on the rebuilding of an interstate highway right now and the Georgia State Highway Department has run a series of tests to try to put this thing to rest once and for all. They came up with some answers on the order of 200 years.

Many studies have been done in France that conclude this is probably the safest and the most stable reinforcing material, since it is galvanized, and has the longest life. They are experimenting with aluminum strips. Right now we are using bonded epoxy strips. They are also using cathodic protection.

In that one picture I showed, they were afraid they were going to get problems with current from the third rail, but that did not materialize.

But, by far, and away, our most stable and best material is galvanized steel. Its life will be more than adequate for permanent structures, particularly in excess of one hundred years.

I have some brochures on the table in the rear that may answer some of these questions, also some photographs and suggestions. Thank you. (Applause)

President Gould: We are running a little ahead of schedule, which quite often happens.

The Department of Energy is next on our program. Mr. Kennedy is not here as yet, but the principal address will be given by Dr. Karel Klima from the Department of Energy.

We usually define energy as something that produces motion or heat and we measure energy in dollars and cents, gasoline, electric bills, heating, and so forth. But, these two gentlemen are going to address the Conference on a broader scope of energy. Dr. Klima. (Applause)

Training of Energy Auditors

By DR. KAREL KLIMA

U.S. Department of Energy - CORO, Argonne, Ill.

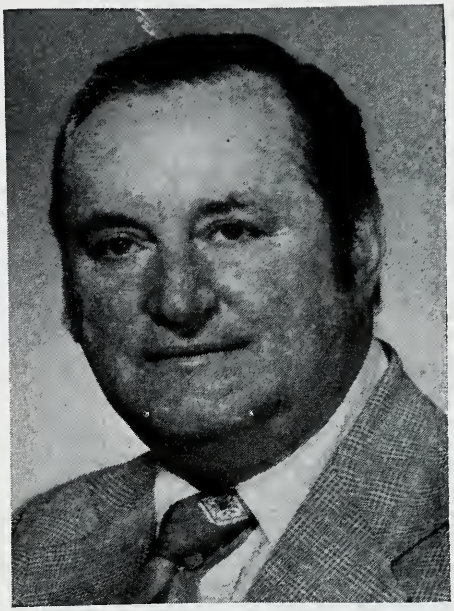
Good morning, friends. Can you hear me back there? Can you hear me on the other side? You are going to have a little problem with my accent so you will have to adjust your typing to my Czech accent. Can you understand me all right? O.K.

This morning something happened that was unprecedented. Mr. Bauer, Regional Manager and Regional Representative of the Department of Energy was going to be here to address you on the National Energy Act. Unfortunately, yesterday, he received a call from Washington that the OPEC countries who are meeting in Vienna are trying to "sock it to us" somewhere from $26 to $35 a barrel for oil. I guess President Carter, Secretary Duncan and the other officials are meeting in Washington and they are expecting some hardships due to the price rise of oil.

So, I am here alone and I am one of you. I am a maintenance man, which is my No. 1 responsibility, and a quality assurance man, and, for a hobby, I work at energy conservation.

Some 47 years ago I was in a meeting like this at the University of Paz and Dr. Einstein was there to address us on the Theory of Relativity and E equals MC square, and so on. At this time, 47 years ago, he was proposing to this meeting of scientists and engineers a shortage of energy worldwide would occur, and, if we had another war, we were going to be paying "through our nose" for it.

I was sitting on my father's lap. He operated the uranium mines in Jachymov, Czechoslovakia. At that time, 1932, only two uranium mines were operating—one in the Belgium Congo and the other one in Jachymov, Czechoslovakia. The atomic bomb did not exist. Dr. Fermi was working in Italy, and Dr. Einstein was still in Europe trying to make some money for a trip to the United States. He was an ex-Professor at the University of Prague and was delivering this address. Seeing me sitting in my father's lap, he pointed to me. He had a little coin in his hand, and he said, "Boy, not too far away, when you grow up to be a man, that coin contains enough energy to supply electricity for a city of one million inhabitants." It was a little copper coin. Enough energy is locked in that coin to supply electricity for one million inhabitants for one year.



Dr. Karel Klima

What he really meant was fusion energy. It was his vision that was the way to go for energy in the future.

Some years passed by and in 1950 I started at Princeton University. I was a

young man, a Graduate Engineer, and I saw Dr. Einstein walking down under the trees, as he did every day. He never rode in a car. Occasionally he rode a bicycle. I said, "Dr. Einstein."

He said, "You speak a beautiful German language." I said, "Yes, I am from Prague."

He said, "You are the same boy I talked to in 1933."

I said, "Yes, that is who I am." He said, "You remember what I told you in 1933?" And this was in 1950 in Princeton. He said Von Braun started building A bombs instead of fusion energy. That was probably a mistake which we made and for which we are now paying. Fusion energy will create a lot of energy.

Good Transportation Needed To Conserve Energy

I do not know about you but I am pro-nuclear. I am also pro-coal and pro-rail. The first day when I came to this country I rode a train from New York for less money than you probably paid to stay in this hotel tonight, and 24 hours later I found myself in Chicago. At that time the railroads were the transportation. The railroads were maintained and the railroads provided good service.

If you study the National Energy Act you will find many suggestions for coal, for solids, for nuclear energy. You find little mention of oil as a potential means of saving energy. This country would be better off if some of the money we are now diverting to other sources of energy would go to the railroads and we would produce good, dependable transportation on the level we had in 1950, when this country was the leading country of the entire world.

That is why I am here today. I want to talk to you about energy conservation.

Americans Must Supply Their Own Energy

As you know, we started this morning at nine o'clock, pretty soon it will be eleven o'clock, and two hours later we have spent at the rate of ten million dollars per hour for the oil which is being imported to this country. That is to the tune of 90 billion dollars per year. That is the reason our dollar is being devaluated and we have no employment in this country. Somewhere, sometime, sometime soon, in the next few years this situation has to be reversed. We cannot afford to send our American dollars to OPEC countries. We have to do something to provide enough energy either produced here or which we have on our hands in the United States. How can we do it?

From the total amount of energy, if one-third goes for transportation, one-third goes for heating, lighting and ventilation of the buildings and houses, it is known that for transportation and transportation alone we can improve the mileage 50% with no problem at all. Let me give you an example.

In 1974 the vehicles in six western states averaged about 12 miles per gallon. At this moment, all vehicles made, all makes, some 75,000 of them, will operate at a mileage of 20 to 22 miles per gallon. So right there you can see the potential saving we have created because we wanted to do something, although five years ago the auto industry in Detroit would tell us it was impossible to do so.

Our home, the average home, I will give you a formula with which to check it—probably uses about 100,000 BTU's per square foot per year. 100 000 BTU's per square foot per year! Those who do not know what BTU's are, let me give you an example. I will give you a farmer's match and we will light it and let it burn. That is one BTU. You use 100,000 BTU's per square foot per year in your average home. How do you check it?

If your home is 1,000 square feet, 20′ X 50′ and your checks for your bills for gas, or electricity, and for water, also, multiplied by the BTU content for the fuel, if that home of 1,000 square feet, uses more than 50 million BTU's per year, you had better do something about your house.

Ways to Conserve Energy

You can do several things. You can increase the insulation in the ceiling to R-30, which is about 12 inches thick. You can fill your walls with insulation to R-20, which would be about 4 inches compacted, and you can prevent the infiltration of air.

One of the biggest wastes of energy is infiltration into the house. Leakage around the basement windows, leaky holes in the foundation, anywhere where a draft is found you have infiltration. So, through storm windows, storm doors, calking, by making your house tight you can prevent the waste of energy. The difference is that you can save up to 50% of the dollars you spent for fuel. If the heating and cooling of your home costs $1,000 right now, you can cut it down to $500.

Later on, in the lobby, I am going to have a little demonstration and anyone who wishes can test it. It has an incremental switch for the thickness of your insulation. It has one for storm windows, storm doors, and so on. You can check it with how many bedrooms you have, you can select any area of your home. Based on that, you can determine how much it costs you to heat and cool your home per year. You can make deviations based on the American Society of Heating and Ventilating Engineers' standards. You can check it for adding storm windows, calking your home and you can see the energy you will save.

If every American homeowner would do this we would cut our consumption of fuel for heating and cooling in half immediately. That alone would result in cutting the imports 50%.

I do not know how many in the room have seen the Chicago Tribune's articles the last few days, but for August we are importing 37% less oil. However, the Arabs are increasing the cost of oil by 14%.

Why We Need Energy Conservation

Let me go back. Why do we need energy conservation? According to the present known reserves of oil in the OPEC countries and elsewhere, including this country, it is estimated that the oil reserves will last until the year 2000 or 2010 at the most. That means we have sufficient crude oil which we are importing at the rate of $290 billion per year for the next 30 years. We have some 20 to 30 years to do something to find new sources of energy, whether it be solids, whether it be the wind, whether it will be fusion, whether it will be coal gasification, and so on—30 years.

The place where I work is known as Argonne National Lab. It has 5,000 employees, 2,000 acres, and we do research on the development of energy, exploring new energy sources, such as nuclear, solar, geo-thermal, battery for transportation and many others.

At Princeton University, the Princeton Plazma Physics Lab, which is owned by D.O.E. and operated by Princeton University, we do research in fusion and energy. Here, if our indications are correct, the first demonstration will be made sometime in 1995, and by the year 2005 or 2010, we will have plenty—plenty—of energy, as plenty as we had in 1950 when we used oil for our resources. The fusion energy is the way to go in the future. It is non-toxic, it is safe, it is plentiful, and the elements which fusion uses is as sea water, and if we can preserve the crude oil until 2000 or 2010, this country will be the leader of all the nations of the whole world in energy, because we have the resources at home. We will have the demonstration plant, we will be in operation and we will not have to go to OPEC to buy their crude oil, which at that point they will not have.

Energy Shortage Is In the United States

How many people here think energy is short now? How many think energy is short? Show me your hands. That is about half. How many people do not think energy is short? That is about one-third. How about the other ones? They are undecided.

Really and truly no energy shortage exists. Would you believe it? Plenty of energy is available in the whole world. The problem is, it is not in the United States and if we have to import it, it is costly and we cannot afford it.

You see, in 1950 we had plenty of energy. We never worried about it. Gasoline was 25¢ or 30¢ a gallon, for which we now pay about $1.35 or $1.40. That makes us think energy is short. The energy is in the wrong hands. We do have plenty of other energy. Uranium—coal—we have coal for 500 years, if we go back to the coal resources, and no one wants to do that because coal is dirty. I do not want to shovel coal into my furnace. It is much easier to use natural gas. We have to go back to coal again.

We will be spending some $20 billion on coal research gasification and the production of synthetic fuels from coal. This is nothing new. In 1945, when General Patton went into Czechoslovakia, he wanted to see three places. One was the 300 white Andalusian horses, which were in Pilsen, a gasification plant and gasoline plant, which was producing gasoline from coal, and the third one was the Jachymov mines. The Jachymov mines, he looked at and he said, "That looks like a mine. I want no part of it." He saw the gasification plant for gasoline and he said, "That looks like a refinery," and he wanted no part of it. The Russians got it. The Russians have synthetic fuel plants operating now. They have nuclear energy on the same level with us. We used to be a leader in nuclear energy. So, General Patton went back to Pilsen and admired his white horses. That is one of the mistakes for which we are now paying, which he made in 1945,

The National Energy Act

In 1978, the National Energy Act was passed in five different bills. The most important bill is the bill on energy conservation. Basically, when you study those hundreds and hundreds of pages, you will find out what we have to do in order to sustain our operations, our gross national product, our way of living. It is to save about 20% of our energy by 1985 compared with our pace in 1975.

What we have to do is, the buildings that are built in the future should use 20% less energy as compared to those built in 1975.

This National Energy Act has many, many other clauses, taxes, reductions for homeowners, but this is basically for private industry, trying to save about 20% of the energy as compared with 1975—a cutback of 20%.

When you saw that movie by the Union Pacific, you saw a little figure there, which probably escaped you, but they save about 9% of their energy used since 1973. So another 10% or 11% by 1985 and they will be in the ballpark, so that we can afford to stretch our resources until 2000 to 2005 to support us.

One of the provisions of that bill is that in public buildings, schools and hospitals, the government will provide some $65 million for the auditing of those buildings. They will provide some $900 million for the renovating of those buildings, so that a building which now uses anywhere from 100,000 to 300,000 BTU's per square foot would be renovated, would be updated to use anywhere from 50,000 to 75,000 BTU's per year. That's the figure you should take home. Go home, measure your home, see how much you are using per year of electric, gas, or oil, or what have you, and if your home uses more than 50,000 BTU's per year per square foot, fix it. Get the insulation contractor, get the calking contractor, pay $600 to $1,000 at the most and cut your electric bill in half. That means that kind of return in a year or a year and one-half or two years at the most. At the same time you have a chance of a tax relief. The government will give you up to $300 for renovating your home. They will give you up to $2,000 for providing your home with solar application, which you might add. Solar payback is not made in a year and one-half or two. It might be five to ten years.

With the cost of energy rising, and I do not know what you may have today, but you may find it would be very practical to put a solar collector in if for no other reason than to heat up your water.

In order to spend $65 million and $300 million in these projects, solar, and so on, we are required that energy-saving factors will be incorporated in the federal buildings which the federal government owns and operates. That will require a special breed of people, a special breed of engineers, engineers who are versed in heating, ventilating and air-conditioning and, at the same time, know the methodology of energy auditing.

Energy Auditors Needed

We in Region 5, which comprises six states, have trained so far some 250 energy auditors. We take a young engineer, we take an engineer, we take a mechanical engineer, an electrical engineer, and we give them three days of training in energy conservation management and what to do in order to make renovating pay back. Three days later they are certified to do the work.

I do not know how many members your Association has but if you would like to offer that type of course to your Association, we would like to conduct it for you, to give you the knowledge of federal registration, federal requirements and regulations, the guidelines, the standards, the energy building jurisdictions, the provisions and the standards of building and energy performance standards, and so on, so when the man comes back, he could be your energy coordinator for your company, the man who is really pushing for a 20% cutback in energy usage. Any time you are saving in the cost of energy, you are really adding up in the profit and loss of your company.

Let me give you an example. The Fermi Lab, which is located about 25 miles away from here, has about 1,500 employees, 6,000 acres, large storage spaces, and a 16-story building, in which operation we are spending some $9 million on electricity alone.

At Argonne National Lab, which has some 5,000 employees and 2,000 acres and 200 buildings, we are spending some $5 million for electricity alone. The last two or three years we audited every one of these buildings and came up with a suggestion, a proposal to cut back on the energy. So far, we have gotten every dollar which we proposed from the Headquarters of Energy and our present savings are 37% from two and one-half years ago when we did not have energy conservation programs.

Many other ways in which to save energy are possible, such as transportation and other activities. I do not want to go into that on this program. All of it is available. We just want to be sure you know about it and it is available to you just for the asking. The training of the energy auditors could be performed for your organization whereby you would have your people coming in here to be trained as energy coordinators to try to save the energy.

At this point, does anyone have any questions? One way to get questions, if you will excuse me for a second, is to offer a souvenir. This is a little gadget for your shower and the first man to ask a question gets one. It costs about 2¢. You put it in your shower and you will cut down your hot water usage by 50%. It is a little plastic adapter. It is one way to save energy.

Now let me go back to the microphone. Any questions for the training of energy auditors.

Delegate: Where should we contact you?

Dr. Klima: I am located at Argonne National Lab, 9800 So. Gas Avenue. And the telephone number is 972-2284. When you have your proceedings for this Conference, the paper will be included in it and it will include my address.

This is not only for the energy auditors. This is for any kind of request you have, energy-related in which we might help you. If you are located here in Region 6, contact me directly. If not, then

we will refer you to the office close to your address.

Delegate: What about using wood for energy?

Dr. Klima: Well, wood energy is very valuable if you have a supply of wood. For example, that reminds me of a proposal I received about three years ago. Some man from Chicago came to tell me he had 15 million railroad ties. Now that sounded real good. He was going to have us do a project at Argonne National Lab, chop those old railroad ties into small pieces and install a wood burning furnace to use them.

Then we asked him, "How much would you charge for them?" Two or three years ago, the price was good. But he immediately knew that he had like a million and one-half expenditure for equipment to chop those railroad ties and have three men operating around the clock, and by the time he would have gotten them to us they would have cost more than the natural gas that we are now getting very cheaply.

Wood is a very valuable source, if you have a supply of wood. Not much wood is available in Chicago or Illinois. You have to go to some other location. If you have ballast, that is another potential for you to use as fuel in your furnace. If you have a wood supply, it is a wonderful way to save energy, and not to use natural gas or oil.

Delegate: I have been wondering about the loss of heat in the home. I am not so concerned about losing the heat through storm windows and what not, because, how much air does a home have to have that you may have fresh air?

Dr. Klima: Enough infiltration is in your home, even the tightest home, that you do not have to worry about the quality of the air as far as oxygen and carbon monoxide is concerned, so that would be the last thing about which I would worry. Normally, the home, as they build them now, has six to ten infiltrations per hour and those are not the waste. It is the waste in energy that you have to have to heat the air and you do not gain anything by it. Just the ventilation through the chimney of your furnace provides enough air that you do not have to worry healthwise about the condition of your house, because no house is so tight that you will suffer damage due to a lack of oxygen because the carbon monoxide will be too high.

Try to calk your home. That is more important. Even if you calk it you are still going to have a 2 or 3 infiltration of air changes per hour in your home. which is more than sufficient.

Delegate: What about problems with dust? Supposing you have a smoker in the family.

Dr. Klima: If you have a smoker in the family, you can always ventilate or you can have a purifier of the air, or he can stop smoking, which is probably my best recommendation. I have done it myself. I used to smoke ten cigars a day and, believe me, you feel much better without it. Some type of device to purify the air might be a better device than to waste the energy.

Delegate: Does Argonne have any of these scrubbers to clean up the air?

Dr. Klima: Yes, as a matter of fact, we do. As you know, we are interested in nuclear energy and we are using it for other things.

Delegate: Do you recommend any particular type?

Dr. Klima: We were so disappointed with those on the commercial market that we designed our own. Nuclear particles were in it and we had to build filters, with 99.99 filtration, and so on, and make certain that some of the elements were removed. But they work — they work.

Any other questions back there?

At this point I would like to introduce Mr. John P. Kennedy, the Director for the Office of Regional Activities in Chicago. John, would you like to say "Welcome" to these lovely people in here. Come to the microphone.

He was going to welcome you to Chicago on behalf of Mr. Bauer, the Regional Representative, and in the maze of transportation, and this hotel, he probably got lost.

Mr. Kennedy: I would only like to

take a second. I was asked to introduce Dr. Klima at eleven o'clock. So, rather than getting lost — I am ahead of schedule. Can you hear me?

As I was saying, I was asked to speak for a minute about the National Energy Plan and to introduce Dr. Klima, which was to take place at eleven o'clock. So I did not have any trouble finding the hotel. We all ended up ahead of schedule, which I suppose we in public service should consider or adopt as well.

Welcome to Chicago. Welcome to Region 5, as far as the Department of Energy is concerned. I managed to hear what I presume were most of Karel's remarks.

As he was indicating, the National Energy Plan is very complicated and has many aspects. What he has done and what I would like to do for a second is just talk about energy conservation measures.

Of course, the whole objective, as Dr. Klima stated, is to reduce the amount of imported oil. I do not think I need to say it any more extensively or any more emphatically.

It is also interesting, I think, that only a couple of years ago our foreign oil bill ran about $42 billion. This year we are looking at something in the neighborhood of $90 billion.

Energy conservation and the aspects of the National Energy Plan, as Dr. Klima has indicated, is made up of a number of pieces of legislation that were legislated by the Congress, as well as initiatives and proclamations, and so forth, that end up in the category of voluntary activity. Dr. Klima has mentioned a number of them so I will not attempt to repeat them.

I think the most important thing for each of us to keep in mind is that the area of buildings, the area of building construction maintenance, and so forth, is an area in which a great deal of energy conservation can take place. It is not a way of generating new energy, but it is a way of preserving and extending our existing energy resources.

Dr. Klima is an interesting individual, as you probably already know. He works with us in the Chicago operations in the Regional Office, which is Midwestern Headquarters for the Department of Energy. He is also very active with the Executive Board in the Chicago area, providing leadership and resources to the federal agencies, as well as state and local governments who are interested in energy conservation and energy management in the upper Midwest. When he says to you that he is willing to accept any request you might have for assistance, I can assure you he means it.

I am sorry I was not here to introduce Dr. Klima at the proper time on the program. I hope he has managed to assist you somewhat in discussing some of the aspects of the National Energy Plan, at least those that deal with energy conservation. I think it is perhaps one of the most important problems, if not the most important, faced by this country, or this world, at this moment. I hope we have managed a little bit to heighten a certain amount of awareness to this problem.

I think the nice thing about energy conservation is that we can do things for ourselves, for our companies, our organizations, our affiliations and for our nation. Thank you. (Applause)

Dr. Klima: Thank you, Mr. Kennedy. The future remarks will be appreciated by those who are in maintenance, as I am, who are responsible for improving facilities.

We do have a little booklet for Maintenance Managers, which, if any of you wish to use in your operations, will give you a full-time maintenance system, and that maintenance system is backed by another guide for people who work in the maintenance department, the foreman, maintenance man, and energy conservation in the Maintenance Department. When you audit facilities, the thing you always find out is that the No. 1 energy saving can be done through the proper Maintenance Department. That is where the actual and quickest savings are.

So, if any one of you would be interested in these two booklets, again they will be listed as part of the presentation.

Let us know and we will help you significantly.

I will give you an example. A year ago exactly, about this time, we went to the Marriott Hotel in Ft. Wayne, Indiana, and 27 people attended a course for energy auditors. At the conclusion of the second day of the course we walked through that building for two and one-half hours. After two and one-half hours of walking through that building we came back and everybody brought in a little report on what they would improve. And 27 people contributed to a 35% energy saving at Marriott Inn at Ft. Wayne, Indiana.

If you spent two days to save 35% of the energy in your organization, I think it would be worthwhile to try.

At this point, any questions for Mr. Kennedy or me?

Delegate: I have understood President Carter is anti-nuclear. Is this true?

Dr. Klima: I do not want to have this as a political issue but I will offer you my personal observations.

Delegate: What was the question?

Dr. Klima: The question was on nuclear energy, and he questions why President Carter appears to be anti-nuclear. I do not think he is. I think he made certain commitments not to make a No. 1 priority of nuclear energy. But I do not think he is anti-nuclear. As you know, we still have some 50% of our activities in the Department of Energy on nuclear. As a matter of fact, we could not put through the year 2010 with our nuclear energy. I do not know how many of you are from the Midwest, but 40% of the energy in the State of Illinois comes from nuclear. It only came because the Commonwealth Edison Company was working very closely with the Atomic Energy Commission, Department of Energy, and the nuclear plants which are operated very successfully in the State of Illinois.

Other states use nuclear energy. Someone was here from North Carolina. Their electricity in North Carolina is derived 50% from nuclear. From my personal observation, he is not anti-nuclear. He just does not make it the No. 1 priority, because of other sources of energy in which you also must become interested. As I mentioned, fusion will probably replace nuclear energy completely. We cannot afford to neglect any potential contribution to our energy picture by the year 2000.

Do you agree with me or do you think he is anti-nuclear?

Delegate: I think he is anti-nuclear.

Dr. Klima: We are still getting pretty good money from him for nuclear energy, so I cannot make that statement myself.

Delegate: You say that by the year 2005 the United States will have the energy problem pretty well solved. What will happen in the other countries?

Dr. Klima: Let me tell you, we have always been a leader and, if we solve our problems, and, we are the biggest wasters of energy, as you know—six percent of the population wastes two-thirds of the energy—if we solve our problem, we will worry about the other worlds, too, somehow. But somebody has to come to the solution. In 1950, you could say that America was the No. 1 country, definitely — technologically, politically, and so on. I do not think we could say it now. We are trailing behind somebody. One thing, we have lost our leadership and therefore we have lost everything. Look at the Iranian situation. Ayatollah Khomeini dares to say anything. He would not have said it in 1950. So, by being technologically first, scientifically and economically first, we will regain that leadership. That is possible if in the next ten years we cut back on the usage of energy, for which we have to pay now, $90 million a year.

Delegate: Will that create sort of a give-away situation again?

Dr. Klima: I do not want to go into the give-away. I want to go into the energy picture only, so that we do not have to go on the outside. If you have plenty, you do not mind sharing it, right? But let us take care of ourselves first.

Delegate: We have heard that alcohol added to gasoline will save some of the energy we use in our vehicles. On the

other hand, the oil companies and other interests perhaps have said that producing a gallon of alcohol requires more energy than the energy that it contributes. What is the truth of that?

Dr. Klima: I am glad you asked that question because that is my favorite hobby. In 1938, Hitler occupied Czechoslovakia. A big, 16-inch oil line came from Romania and ended somewhere near Vienna. When Hitler got hold of it, we lost all our oil supply. We were in a worse situation than this country ever will be.

The first thing we had to decide was, what are we going to do to replace it? Maybe you do not know, but in Czechoslovakia we had many potatoes and many sugar beets. Within six months hundreds and hundreds of plants were constructed, over night, to produce alcohol.

In 1940 and 1941, the mixture of gasoline in Czechoslovakia was 20% alcohol and 80% gasoline. As a matter of fact, I talked to John Sweringen, the Chairman of Standard Oil Company, and, you know, sometime ago he was against gasohol and what have we got to gain, and, you know, he had the argument it was going to take more BTU's to produce alcohol than what it is worth. I told him, "John, did you know that the Standard Oil Company and Mobil in 1937 and 1938 were putting 20% alcohol into gasoline because the government told them to do it, and no other way, either get out or do it, so they did it? So he researched it and he apologized, he said, "We did it." I said, "Do not say that Standard never did it before. You did it and you have forgotten about it, because the energy was so plentiful and cheap that you were not interested."

You can see the reversal of the attitude of the oil companies lately. 1,600 Texaco stations in Iowa and some 1,500 in Illinois sell gasohol. In Argonne we have three or four of them.

I have just attended a meeting on alcohol fuels in Springfield, Illinois, and alcohol is the way to go, really. The question which you raised, that it takes more BTU's to produce alcohol than what it is worth is not true. It all depends on what you do. If you distill whiskey, it takes more BTU's than whiskey is worth as a fuel. If you distill alcohol for transportation, it takes only about 50% to 60%. It does not matter how many BTU's you are going to use if you use coal for distillation of alcohol because we have plenty of coal.

Now, what I am trying to tell you did not come from me. This is a one million dollar project at Purdue University, funded by the Department of Energy, and they came up with the answer of 60%. Research is being done at the Ames Lab and they know it takes half the BTU's needed to distill what is being produced. We have the coal, so we do not really care how many BTU's we use to produce that alcohol because we are not paying for oil. But alcohol to replace 10% to 20% of the gasoline which now goes to the OPEC countries is a plus. At the Fermi Lab, which is our other research lab, we are using a gasohol mixture. We have been doing this for the last six months, 15% alcohol and 85% gasoline. We have had no problem at all. This winter we are going to 20% alcohol, as we did in Europe 35 years ago. You will encounter no problem at all. As a matter of fact, we have some 17 vehicles on display in Springfield, Illinois. which are fueled completely with alcohol—100% with alcohol. We have an airplane that flew from California to Chicago on 100% alcohol. Astronaut Cooper was one of those who piloted the plane.

Now let me tell you, they told him when he started taking off with the airplane, fueled by 100% alcohol, the EPA, Environmental Protection Agency, said that it was illegal. He said, "Going to the moon was illegal, too—but I did it." That is the type people you need in order to break through and do what has to be done.

Delegate: Will alcohol work as a diesel fuel? If so, it would mean a great saving in our line of work.

Dr. Klima: That is another very good question. Let me tell you what we did with a diesel engine, and this is not only

this August, but we did it last April and November of last year. We started a diesel engine with diesel fuel. Then we diluted the diesel fuel with alcohol, and it ran. And on top of it, when the engine got hot, we ran it on a mixture of 50% water and 50% alcohol. You see what can be done? Fifty percent water and fifty percent alcohol. But you cannot tell that to the engineers because they know it will not work! You have to do it with a guy who is willing to make it work.

We want luxury — we want leisure — we want to pull up to the station, start and pull away. During the war, when we ran out of gasoline and ran out of alcohol, we tied a big cart behind the car, 24 inches in diameter and 6 feet tall, and put wood in it, chopped wood, one-half inch by one inch, something of that nature. You woke up one hour before you had to leave your home. You started a fire, and you got methane, which was gas, on which we drove during the last three years of the war, until 1945. I know that is possible.

Somebody asked a question about wood. Even wood could be used properly gasified to power the car. Means and ways, many ways, hundreds of ways to do it, but someone has to try it first. Always some people will say it will not work—until it works, and then they apologize.

You know, gasohol is one of these problems. What would interest an oil company to sell gasohol? They do not make money on alcohol. They pay maybe a buck seventy-five per gallon and they cannot mark it up. No taxes are on it. So they are not interested in selling gasohol — until somebody forces them to do it, either public opinion or government regulations. To go the government regulation route is sometimes wrong. It takes public opinion. If you are the driver and you stop at the gasohol pump and fill up with gasohol, you will then be the one who tells the big oil companies you do want gasohol. By the way, they are not first in that, either. Brazil, you know, uses so much alcohol it is unbelievable. They make it from sugar cane. They are selling the alcohol here in our ports at $1.00 a gallon. It costs us something like a dollar sixty-five a gallon here.

We already have a plentiful supply, but that is not any better than the OPEC countries because we are exporting good green dollars for the alcohol, which we could make here.

In the film shown by the Union Pacific, did you see all those potatoes in Idaho? I go there about twice a year. Two years ago I went there and the potato farmers could not sell their old stock. You know what they do? They just dump them. If somebody had sense enough to mash them and make alcohol out of them we would have had a hundred million gallons of alcohol. That is possible.

You see, we have two different things —potatoes for eating and potatoes for alcohol. If they are not suitable for eating, then use them for alcohol.

The same with this nonsense they exhibit when they tell you that you will use good grain and good corn and the world is going hungry. This is not true. Out of a bushel of corn, you get sixteen pounds of protein, which may be used as a food, fine protein, and you get two and one-half gallons of alcohol as a by-product. Right now we sell a bushel of corn for $4.00 to Russia, whereas if we processed it here we could make $21.00 from it. We would get two and one-half gallons of alcohol, plus the protein, a very fine protein, which now we can sell to Russia. That is the way to do. You get the labor and you get the profit in America and the product is exported, like we used to do in 1960. But we import more than we export nowadays. That is our problem.

Delegate: Would you care to say something about producing cellulose from corn and making alcohol from the residue?

Dr. Klima: Particularly, that technology, is one in which I am not involved. You are now in the ethanol range. It is available right now. It is not commercially available but it is in the stage that could be commercialized tomorrow if somebody would care to make the cap-

ital expenditure. You see, you must remember we are a capitalistic country. You must have the demand, otherwise no one will produce it. If a shortage of alcohol developed right now, within the next few years you would have many big plants producing alcohol. But somebody has to finance them and somebody has to take the business risk. Otherwise, you would make alcohol and no one would use it.

It is a developing curve right now. You cannot have it overnight. Five years later, when you and I meet, you are going to see the difference. You will probably be driving your car on 100% alcohol. As a matter of fact, on August 12th a representative from the Ford Motor Company stated they do produce cars in Brazil which are fueled with 100% alcohol. They are going to make a small run on 100% alcohol fueled in this country, and I want to be the first one to buy it, and I have that promise.

But somebody has to make a decision. The same with electric cars. We are developing batteries at Argonne National Lab. The battery will not be ready for a car until 1984 or '85, but when it is, be the first one to buy it because someone has to push that market. It is not that difficult. When you get home you plug it in. You will get a 50-mile radius, you probably drive only 40 or 50 miles a day, it is a perfect car for you or your wife to use, and you will be eliminating gasoline, for which we are paying money now. That is what we are going to need, electricity, the extra electric power, which is available right now, but between ten o'clock at night and seven o'clock in the morning we could charge a battery, using it for cold storage, for making ice, reverse the cycle a little. Right now everyone wants to do everything from seven o'clock in the morning to four o'clock in the afternoon and the plants are running with either nuclear or steam only eight hours fully utilized, and sixteen hours could be fully utilized.

Ingenuity has to develop means and ways of how to utilize these plants so we are utilizing the energy they are producing.

One more question?

Delegate: What is the solution to the disposal of atomic waste?

Dr. Klima: That is not an easy problem to answer but it is not difficult to solve at all. If we had a breeder reactor operating right now, you would not have high nuclear waste because the fuel from the fission reactor would be used in that breeder reactor. The problem still remains what to do with that low grade waste, one or two percent, and that is the government's responsibility. No one else's but the government. They are working on it. Money has been provided recently for providing storage and so on.

Way back, we do not even know when it happened, some several hundred years ago, a nuclear reactor operated in Africa, a natural nuclear reactor. No one made it. Interfuel in uranium started the chain reaction. No one knew about it until we could measure radiation. Nuclear waste is there and no one worries about it.

We are sloppy about our nuclear wastes in this country and if the government enters in and spends money on it, no problem should be connected to nuclear waste.

I do not think a serious problem with nuclear waste exists. I think it has been magnified in the newspapers and news media to greater proportions than is actually the case. What I see, and I am in quality assurance, in our operation of nuclear reactors here, Argonne, and so on, where the government is operating it you have no sloppiness. You turn it over to a private sector and sometimes they do not do exactly what is prescribed should be done. That is why we have so many violations, even in the nuclear plants which are commercially operated.

So if we will just put tough regulations on it, tough quality insurance rules, do not let them deviate, we will not have a nuclear waste problem. We can have many other problems, other toxic problems, in our country, which are greater than the nuclear problems about

which we now worry. The unknown about nuclear energy is insidious. You do not feel it, you do not see it, you have to measure it to understand the danger. Other ingredients you can smell, you can taste, and so on. So, people worry about nuclear, I do not know why, but they do not worry about the others.

Your water is probably so badly polluted you should not be drinking it. But very few people write about it. It is probably more dangerous than any other ingredient.

A solution to the nuclear problem is an ongoing program now and no problem will exist five years from today. But the government has to become involved. We were hoping that someone in the private commercial sector would take it as a means of making it safe. But no one has taken it on. As you know, we had a station not too far from the Loop where General Motors was going to process waste. The design did not pan out and no one wants to put any money into it because the Atomic Energy Commission does not exist, and always the question, "Will the government finance us?," and such questions.

Technically, it is no problem. Financially, it is a problem. A few more years and no problem will exist with nuclear waste, properly handled. Any more questions?

I confused General Motors with General Electric—but it is just the same. (Laughter) Maybe it is better.

Delegate: What about the use of garbage as energy?

Dr. Klima: We have several projects operating to deal with waste heat. The best example I can give is the City of Milwaukee. They are doing a marvelous job with it. How they do it, I do not know, but they do. We have it in the City of Chicago but it is not operating as well. I think it is the people behind the process which makes it work or it does not work.

Garbage should not be buried. Everything which has a BTU content should be used for energy. Do district heating with it, or whatever. The waste disposal is going to be another problem this country must face in the next ten to fifteen years. We do not have the land on which to bury it. We must burn it. We must burn it so that we regain energy and do not pollute the air, and processes can do it.

In Pompano Beach, Florida, they have a project going right now. If you want to visit it, I will give you the address. They think it is feasible. Waste Management from Oakbrook is the project manager on it. We do not have any negative report on it, but you must have the desire to make it work. The City of Milwaukee is the best example. They make money on it, on burning the garbage.

Any other questions? Thank you very much for inviting us. And if you do have any problems, please contact us at the Department of Energy, either at our downtown office or at Argonne National Laboratory. We are here to help you. It has been a pleasure talking to you. (Applause)

President Gould: Thank you, Mr. Kennedy, and Dr. Klima.

I have a note here that we have as of ten o'clock this morning registered, 84 B & B members, 6 associates, and for Roadmasters, we've registered 157 and 197 associates, and 62 guests—a total as of ten o'clock this morning, 505 people, which is pretty good.

President Gale, do you have anything else to add?

At 1:15 this afternoon, the Roadmasters will meet in this room. The Bridge & Building will meet at one o'clock in Regency "C,' which is right next door. I guess we are a little bit slower in getting things done so we have to start earlier. So it is one o'clock for the B & B, and for the Roadmasters, 1:15

I declare this meeting adjourned. Thank you.

. . . Recessed at 11:22 A.M.

MONDAY AFTERNOON SESSION

September 15, 1980

President's Address

By D. C. GOULD

Assistant Structural Engineer, UP, Omaha, Nebraska

I hereby call this 85th Conference of the American Railway Bridge and Building Association to order and offer a cordial welcome to visitors, guests and members attending for the first time. May I also extend a sincere invitation to all the ladies to attend any of our sessions that may be of interest to them.

It is my pleasure to introduce the officers and directors of our Association:

Junior Directors:

Mr. P. H. Saletnik, Asst. Engineer Buildings, C&NW. Mr. Saletnik is Chairman of the Advertising Committee and Resolutions Committee.

Mr. J. N. Michel, Manager Engineer Design, Amtrak. Mr. Michel is on the Registration Committee.

Mr. D. A. Bessey, Asst. Chief Engr. of Structures, Milwaukee Road. Mr. Bessey is on the Registration Committee.

2nd Term Directors:

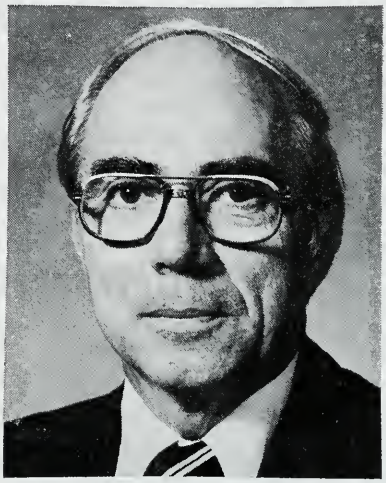
Mr. J. M. Williams, Bridge & Building Supervisor, EJ&E. Mr. Williams is on the Program Committee and Chairman of Special Features.

Mr. C. M. Russell, General Bridge and Building Supervisor, Southern. He is on the Public Relations and Greetings Committee, and Special Subjects Committee and Chairman of the Membership Committee.

Mr. J. W. Davidson, Asst. Director Bridge Engineering, B.N. He is Chairman of Standing Committee on Training of Bridge & Building Foremen.

Senior Directors:

Mr. W. S. Stokley, Roadway Engineer, I.C.G. He is on the Proceedings, Resolutions and Hotel and Conference Committees and Joint Association Representative.



D. C. Gould

Mr. W. J. Gunkle, Senior Structural Inspector, ConRail. Mr. Gunkle is on the Necrology Committee and Chairman of the Registration Committee. He also serves on the Ladies Entertainment Committee.

Mr. O. C. Denz, Supervisor Building Maintenance, Milwaukee Road. He is Chairman of the Ladies Entertainment Committee and Proceedings Committee, serves on the Hotel and Conference Committee.

Mr. W. C. Sturm, Senior Project Engineer EJ&E, who is our immediate Past President and Chairman of the

Hotel and Conference Committee, Nominating Committee, Joint Association Representative and Standing Committees.

Mr. W. R. Hyma, Bridge Engineer-System, AT&SF. He is a Jr. Vice President and Chairman of Special Subjects Committee.

Mr. R. C. McMaster, Manager of Facilities and Structures, B&LE. Mr. McMaster is a Jr. Vice President and Chairman of Public Relations and Greetings Committee and a member of the Proceedings Committee.

Mr. J. W. Chambers, Bridge Construction Engineer-MoPac. He is our 1st Vice President and Program Chairman.

Mr. W. E. Armstrong, Engineer Buildings, Milwaukee Road. Mr. Armstrong is Treasurer of the Association.

Mrs. Ann Wilson, Secretary of the Association. Mrs. Wilson's duties at the registration desk keep her from being with us at this time. She will be with us at Wednesday's business session. During the past year Mrs. Wilson's help has been most valuable to me. She is doing an excellent job in managing the Association's office.

You may now applaud this fine group.

Thank you, gentlemen, you may be seated.

As required by the by-laws of our Constitution it is my duty to report the condition of our Association.

Our financial condition is good; we continue to maintain an adequate bank account and have funds invested in interest-bearing securities. A detailed financial report will be given by our Treasurer, Mr. Armstrong, at the Business Session on Wednesday.

In face of increasing costs of operating, our Association has been able to retain the $7.00 membership dues. The success of paid advertising in the Proceedings Manual contributes to our sound financial position. Please continue to support those who advertise in the Proceedings Manual.

Membership remains about 700 and has not changed significantly for the past several years. Like a car that has not moved for a long time and rusts to the rails, our membership appears to have rusted to the number 700. I could give you all kinds of excuses why we have not grown in membership. One proven way to assure growth in our future membership is, for each member to sign up just one of his fellow associates.

(Pause)

1980 will be remembered as the year initiating railroad mergers which will re-align the future of our transportation system, making it into an effective, efficient mover of bulk commodities, manufactured products in large volumes, and the one-and-only method to transport the exceptional heavy-high-wide-load. While the wizards of finance will be wrestling to determine which companies will survive the mergers, the Maintenance of Way Departments will be asked to solve the new problems which will arise when maintaining the unfamiliar facilities of the merged lines. To assist in keeping our members abreast of the latest thinking on materials and procedures in railroad construction and maintenance, the Association will continue to search out speakers, collect technical papers and bring to you information on the once little-understood skills for dealing with personnel, a changing environment and work incentives.

By looking at your program you will see that this Conference will begin to fulfill these objectives. Much of this material is able to be presented only because of your assistance. I have been continually gratified by the concerned helpfulness of the members.

Your continued contribution to technical papers and volunteering to address these Conference Sessions in 1981 will assure the continued growth of the Bridge and Building Association.

Our Association's programs over the past years have dealt with the material and physical aspects of Maintenance-of-Way. I am very pleased to introduce our next speaker and her subject per-

taining to the human element involved in maintenance and construction.

Ms. Yvonne A. Method-Walker, Management Development Officer, Personnel Department, Union Pacific Railroad.

Ms. Method-Walker holds degrees of Bachelor of Science-Social Welfare, Ohio State University; Master of Arts in Education-Guidance and Counseling, Inter-American University, Puerto Rico. She has been and, is, most active in her career working and volunteering in counseling for the University of Nebraska, Omaha, Greater Omaha Community Action, Offutt Air Force Base, Boy Scouts of America, Iowa Western Community College, Young Women's Christian Association, and numerous other organizations. Ms. Method-Walker was born in Covington, Kentucky and the mother of Van Dyke, aged 13.

Ms. Yvonne A. Method-Walker.

Emerging Challenges for Management In the '80's

By YVONNE A. METHOD-WALKER

Management Development Officer, Union Pacific, Omaha, Nebraska

Thank you, President Gould and good afternoon to members and guests of the American Railway Bridge & Building Association. It is indeed an honor and privilege to be with you at this 85th Annual Conference.

When Mr. Gould and I met to brainstorm about some contributions I could possibly make and about the ideas I could share relative to personnel management, he provided me with some data about the audience which I would be addressing. Rosabeth Moss-Kanter has produced a slide presentation entitled "A tale of O" which addresses life in organizations. She talks about "O-ness" as being one of the few among the many "X's." "O-ness" could be being: Short among the masses being tall; elderly amid youth; healthy among sick. My "O-ness" today is being a "baby railroader" amid those convening here for the conference and/or congregated in this room who have—collectively—thousands of years of railroad experience; and my "O-ness" is being in personnel while the many are engineers.

Yvonne A. Method-Walker

Being different, an "O" among sameness, has advantages—one of which is

the ability to bring another viewpoint, another perspective, another dimension to an established group. I am not here to talk about an area of which I know little; rather, I want to provoke your thinking as managers, supervisors, and line personnel as to how work-life will be impacted in the decade of the 80's.

I've entitled my presentation "Emerging Challenges For Management in the 80's," and my discussion will focus on:

a. What the emerging workforce will be or look like;
b. Potential areas of concern or conflict for managers;
c. Implications/challenges for management in terms of what needs to be addressed in order for companies within our industry to continue to be efficient and successfully competitive.

The 80's will serve as witness to some very interesting phenomena as it relates to people who work. The emerging workforce, in part, will be younger—kids, youngsters, upstarts as perceived by the "old timers." They will be products of the "good life" which many of you have worked 25-30 years to provide. They will want money, status and promotion immediately for they have high career expectations. Why not? They've prepared themselves educationally with six or seven years of schooling beyond high school and feel ready for management experiences. They are professionals.

The emerging work force will include more women. Over the last three decades, participation on the labor force by women rose from 25-45%+. This figure now and in the future represents not only women in traditional, lower-paying jobs, but women who are professionally competent and have career aspirations toward non-traditional fields, including top managerial/executive positions. Witness female engineers, switchpersons, dispatchers, claim agents, corporate lawyers, managers in marketing and long-range planning, vice presidents of large corporations.

Token hire of blacks and other minorities for "show case" purposes is, hopefully, over. It will be important to recognize that the labor force in this decade will **continue** to include qualified, educationally prepared minorities who desire to successfully compete for available positions. The career aspirations of this particular human resource will be similar to those of the already established, traditional work force: upward mobility, responsibilities commensurate with written function or job description, opportunities for continued professional development, freedom to maximize individual potential. The 80's manager can increase the organizational "bottom line" by insuring the **active** work participation of blacks and other minorities, not just "passive presence."

Because of the different appearance of the work force of the 80's—younger, educationally prepared, which suggests another definition of "experience," professionally-competent minorities, and women—the traditional older, white, male manager may find himself somewhat overwhelmed by this diversity in the work place.

The traditional work values of "X's"—familiar ones that make sense—loyalty, job security, stability, dedication, strong identification with work roles—may not be as readily identified in the contemporary work force. Often this difference or variance has been identified as a decline on the work ethic. I would suggest to you that perhaps the existence of **conflicting** work ethics would be a more appropriate observation: traditional work ethic vs. a new work ethic.

The contemporary worker values individuality and personal growth opportunities on the job. The freedom to be creative is important as is the need for recognition and reward. Loyalty, job security, stability, identification with personal roles, rather than only the work role, create the chasm between the old and the new. Earning money to provide and take advantages of "The Good Life" a leisure and recreational society embodies is an important value indigenous

to the contemporary work force.

Authoritative, hierarchical management styles are incongruent with this work force. The "new breed"—because of their educational endeavors as well as disconcertedness typical of the times—think critically and analyze. Authoritarianism is resented but proper exercise of authority is not opposed. It is no longer automatic, then, for employers to calmly accept without question the values, goals and organizational patterns of behavior that are more characteristic of a traditional labor force whose work life was their total life, often times experienced with great dissatisfaction.

The intense competition for available jobs is another conflict to be experienced in the 80's. It's a phenomenon referred to as the "middle age bulge"—the 25-44 year old age group which will comprise 50-52% of the labor force. These are the individuals who will be severely crowding the lower ranks of management and competing for promotions, professional recognition, elements of career development. There will be a lot of "jostling for position," embellishment of credentials, attempted acceleration from the company by older workers who occupy the "Room at the Top." The lack of opportunities for upward progression is a central issue and subsequently poses a challenging problem for managers: alternative definitions for success and career pathing.

Given the appearance of the contemporary workforce—inclusive of minorities and women, professionally talented persons regardless of gender or race; and secondly, given the potential issues management will be confronting—conflicting values, resistance to traditional, old-style authoritative management, the "Middle Age Bulge," highly competitive work environs—the implications are, then, that effective management and supervision for the 80's should reflect an awareness of the issues and concerted efforts to resolve areas of dissonance. What will be needed are not new forms, nor new ways of proving why change and "differences" are hard. Rather, the emerging challenging is to develop strategies for making change and/or transition smooth and painless.

Companies will have to demonstrate a greater responsiveness toward the worker in terms of shared decision-making or participative management. While employees do not necessarily aspire toward making corporate or top-level management decisions, they want to have some responsibilities in formulating policies and making decisions specifically relevant to the areas in which they work. Issues which are directly related to their jobs and job performance are issues about which workers want to have input.

Managers, on the other hand, tend to cherish authority yet worry about having too much responsibility. This preoccupation with responsibility does not necessarily allow for "letting go," delegation, and/or shared decision-making. If managers would be flexible enough to meet the challenge of participative management through a genuine set of motives, they would be demonstrating responsiveness to the contemporary work force which desires to be a part of the decision-making process. An additional payoff would be the demonstration of a basic belief in the ultimate value of this individual and his/her role in the organization. Letting people know what is expected of them, defining challenging goals for individual self-esteem, regular feedback regarding results should occupy management strategies during the 80's.

The challenge of trying to "mesh" the importance of the personal role and needs of the individual (as opposed to the work role only) with organizational objectives requires that the coaching and development of employees occur in the most positive and meaningful way.

I am proud to be able to say that efforts at Union Pacific Railroad are evidenced in those alternatives just identified. The Manager Action Program (MAP)—which is an operating department program—is an excellent example of an attempt to provide developmental

opportunities to employees to increase managerial effectiveness.

The Manager Action Program content includes discussion and work on communication styles, how to establish the freedom to work creatively and solve problems without getting "blown away" for being innovative; job agreement, performance appraisal; and on-going developmental feedback in recognition of the employee as a valuable human resource with competencies and contributions for organizational success. An additional content piece of the program explores the value differences of the work force. Some open discussion between bosses and subordinates around the areas of conflict and identifying how or what values come into play can serve to allow for mutually satisfactory modifications of value systems which may be in conflict. An adjunct challenge or critical issue becomes the degree to which management can sharpen its decision-making skills to successfully identify, anticipate and address changing values.

One final strategy I'm suggesting is to give attention and commitment to advancing the quality of work life which would result in greater esteem for individuals and for groups and, subsequently, greater benefits to the organization. This translates to advances in productivity on an individual basis, since employees bring to the work place human values which accentuate positive performance on the job.

It seems, then, that the all-encompassing challenge which emerges for the 80's managers is to create an impactful balance between a task and people orientation. Our industry wants to remain successful and competitive with productivity at a premium. The contemporary work force which will be responsible for making that happen looks different, thinks differently and, perhaps, works differently. But it has goals not totally uncommon to those of the more traditional work force.

Youth, education, blacks, women, other minorities represent the composite contemporary work force which can positively interface with a more traditional (older, white male) labor force in order to meet the industry's objectives. The human resources within our companies will strive to be the best and to give their best as long as what is required compliments individual and personal goals.

The 80's are here, the challenges have emerged. In this decade, top management can dedicate itself to exploring creative methods which will allow for job satisfaction to be redefined in ways which will embrace changing work ethics and values. Participative management, job agreement, on-going performance feedback will be important considerations to insure that the worth of the human resource shall not be lost.

I wish to thank you for your attention and the opportunity to have been with you. This has been one of my much appreciated personal challenges in the 80's . . . thank you.

President Gould: Thank you Ms. Method-Walker for addressing our Association and your time to come to Chicago.

Mr. J. M. Williams will introduce the next speaker, Mr. Don Bessey.

Our second special feature for the 1980 American Railway Bridge & Building Association Conference is a report on "The Reconstruction of Mississippi River Bridge at Hastings, Minnesota" by D. A. Bessey, Asst. Chief Engineer, Structures of the Milwaukee Road, Chicago, Ill.

Don A. Bessey graduated from the University of Illinois with a degree in Architectural Engineering. He joined the Architectural Department of the Chicago, Milwaukee, St. Paul and Pacific Railroad shortly after graduation. He became Asst. Architect in 1955 and was promoted to Architect in 1973. On July 1, 1979 he became Asst. Chief Engineer Structures. Don has been a member of AREA and an active member of Committee 6 for the past 27 years, serving as chairman of Committee for three years. He is presently a member of the Executive Committee of the ARB&BA.

Reconstruction of Mississippi River Bridge at Hastings, Minnesota

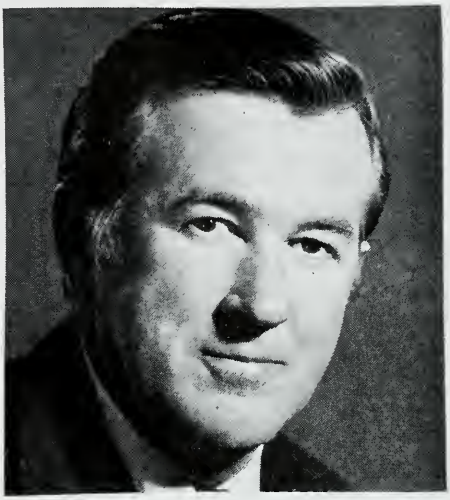
By D. A. BESSEY

Assistant Chief Engineer-Structures, Milwaukee Road, Chicago

Members of the Association and Guests:

First of all I have somewhat of an apology to make. Approximately nine or ten months ago when it was decided that this presentation would be made at the B&B Conference in September of 1980 I began accumulating slides of the various phases of the construction of the bridge. It is always the B&B Association's intent to present current subjects. This particular presentation is so current that it has not yet happened. This is not really true. A little explanation—we had originally anticipated that the reconstruction of the Mississippi River Bridge L-268 at Hastings would be completed by July or August of 1980. Well, that has not happened. Due to numerous delays and other factors beyond our control, the final phase of the reconstruction project has not been completed. This final phase, as we will discuss further in the presentation, is the float-in of the 320′ lift span. We now anticipate that this float-in will take place sometime later this month, or around the first of October.

I still plan to take many pictures of the float-in process and I am sure other pictures will be taken by the contractor and the consultant. So I hope in some future date we will be able to show you the conclusion of this construction project. Not only the conclusion but the most interesting aspect of this project.



D. A. Bessey

History of the Bridge

The Milwaukee Railroad Bridge across the Mississippi River at Hastings was built under authority of an act passed by the Minnesota Legislature on February 6, 1864. The original bridge was constructed in 1871 and it consisted of a 300′ iron truss swing span, two 150′ iron truss spans, one 130′ wood and iron truss span, and, also 150′ of timber trestle at the east approach and a 1,450′ pile trestle at the west approach. Numerous replacements were carried out in the late 1800's and, then, in 1891, the swing span and the two 150′ truss spans were replaced. The 300′ swing span provided a 106′ channel on the east side of the center pier and a 130′ channel on the west side of the center pier. Due to other construction that has taken place, the west channel was reduced to 126 feet. These channel widths were adequate for 1891, however, with present day river traffic with a tow three barges wide, or 105 feet, the 126′ channel provides inadequate horizontal clearance.

In searching the files I find the first reference to a proposed renewal of this structure in 1916. The proposal included the installation of a 350′ swing span which would give a 160′ clear opening. In other studies, in the same year, a 400′ swing span was proposed which would provide a 180′ clear channel. Ten years later a proposal was made to reconstruct the swing span at a cost of $102,000. The 360′ span was estimated to cost $160,000. This was back in 1926. In 1929 another proposal was presented to construct a 215′ lift span giving a 50′ vertical clearance at the cost of approximately $530,000. This was the first reference to the construction of a lift span. Instead of progressing any of these renewal projects, in 1930 the existing swing span was strengthened. Then in 1943 the swing span was converted from steam operation to electric operation.

Then in 1944, during World War II, some preliminary discussion was made to alter the structure for proposed navigation improvements under the cost-sharing policys of the 1940 Truman-Hobbs Act. The Truman-Hobbs Act allows the Federal Government to order the alteration of a bridge which obstructs navigation and provides guidelines for the sharing of the cost of such alterations between the Federal Government and the bridge owner, in this case—the Milwaukee Railroad. Nothing more was progressed at this time. Then on November 30, 1948 a "Notice to Alter Bridge" was received from the Department of the Army. A "Notice to Alter" was issued, however, due to delay in financing, and, numerous other postponements, no other action was taken until approximately 21 years later.

In 1970 Stan Thoroughman, who, I believe, is present in the audience today, Chief of the Bridge Section, of the Second Coast Guard District in St. Louis, held an informal meeting in Minnesota, to gather information that would assist the Coast Guard to reexamine the priorities for the alteration to the Milwaukee Railroad Bridge at Hastings. Public Notice was issued and then in August of that year the Coast Guard advised that this project did not have high enough priority. The following year, in 1973, Mr. Thoroughman again indicated it was to be resubmitted. In 1974 we were advised that the bridge was being placed in line for replacement. On May 26, 1976 authorization to proceed with drawings and specifications for the reconstruction of the Milwaukee Railroad's Mississippi Bridge L-268 at Hastings, MN was issued by the Coast Guard.

Reconstruction Starts

The railroad retained the services of Howard, Needles, Tammen and Bergendoff, of Kansas City, to prepare the construction plans and specifications for the reconstruction of the bridge. The drawings and specifications for the bridge were completed in March of 1977. However, here again the budget allocation was delayed, and a starting date was deferred. In May of the following year, 1978, the Coast Guard approved going out for bids, the bids were issued in June of 1978 and were opened in September of 1978. The contract was signed in November with Hensel Phelps Construction Company, Greeley, Colorado. A pre-construction meeting was held between the Milwaukee Railroad, the consulting engineers and the contractor on November 28, 1978 and actual construction began in January of 1979.

I would now like to show you the progress of this project with a slide presentation.

Mr. Bessey showed slides which included pictures of the bridge in the 1930's and a view of the Hastings Bridge as it appeared in 1965. The structures starting at the east end, or right side of the pictures consisted of a 38′ deck girder span, one 300′ swing span, two 147′ through truss spans, a 56′ deck plate girder, 21 - 50′ deck plate girders, with a total length of 1,755 ft. The portion of the structure to be replaced consists of the 38′ girder span, the 300′ swing span and the first 147′ truss span.

The main reason to alter the structure was for navigation improvement. Another reason for the replacement of the structure was the down stream center pier protecting crib which was hit 12 times in 1979, causing damage in excess of a quarter of a million dollars. This crib, of course, will be removed when the new structure is completed.

Slides of a barge tow entering the 126′ wide channel west of the center pier of the old bridge showed the extremely close clearance between the barge and the bridge structure.

Slides showing the existing bridge from the right hand side, the 38′ girder span, the 300′ swing span, the two (2) 147′ truss spans and, the new structure which is a 55′ span with an east tower, the 320′ lift span and span #3 which is 104′ and the present truss span 147 feet remains. The total length of the new structure is 489 feet.

Several slides showed the various phases of the reconstruction of bridge L-268.

The next slide sequence indicated the rebuilding of span #1. 55′-0″ span. Preliminary construction work involved with bobtailing of the swing span; removing the existing 38 foot deck girder span; leap frogging a portion of span #1 into place; and bobtailing of the existing swing span. The old Span #1 was 38′ and the new span is 55′. Therefore, it made it necessary to bobtail the swing span.

Temporary end posts were welded into place and removal of the existing end posts; counterbalancing the swing span after the bobtailing operation to make up for the loss in weight; moving the swing span into place after the bobtailing operation has been completed. The first train over the new Span #1 was an Amtrak train on Tuesday morning, November 6, after 50 hours of outage.

Then he showed slides of the construction of the towers at Span #1 in Feb. 1980, showing the installation of the main shive on top of tower #1; filling of the counterweight of Span #1 with heavy weight concrete, in Aug. of this year.

Then the next phase of construction, the assembly and placement of Span #3 and the temporary jump span. Slides showed the construction of the false

Change out of Span #1 which took place November 4 and 5 of 1979. Also indicates bobtailing the existing swing span.

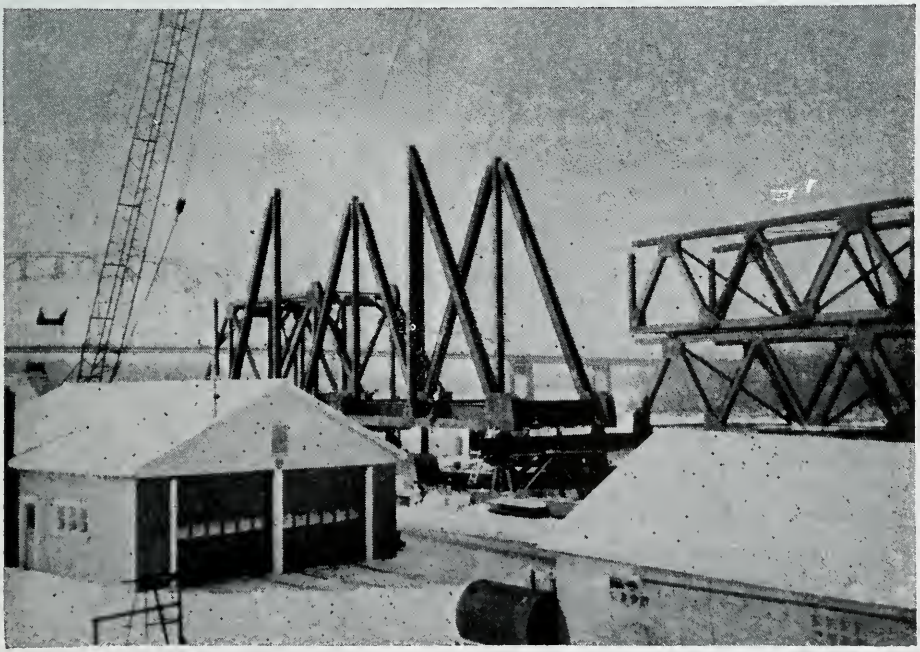
work where Span #3 and eventually the lift span will be constructed; the construction of the temporary jump span which will go between old Pier #3 and new Pier #3; the protection cell for Pier #1 being constructed; filling the protection sell at Pier #1.

While the construction of Span #3 was underway and during the winter months, with no river traffic, the contractor proceeded to dismantle the up stream center pier protection crib. Slides showed the demolition of the center pier protection which was necessary to eventually float in the lift span. The timber crib has been removed with only the nose remaining; the loading Span #3 on to the barges to be floated into place; Span #3 being floated through the open channel to be floated into place —approximately 300 tons; Span #3 moving through the open bridge to be floated into place; the barge floating Span #3 into place to pick up the existing span and place the new Span #3; the new span on the right and the existing span on the left; the floating in the new span and floating out the old span; the old span being replaced by the new span; the new span in place with the old span carried on the false work on the barges; preparing the jump span for installation; placement of the jump span between the new Span #3 and the existing swing span and the temporary jump span in place. Taken June 1980.

The next phase of the construction was to erect the towers on the Span #1 and Span #3; then the assembling and placing of the 320 foot lift span. This is the part of the project which has not as yet been completed; total length of the new structure 489′-0″. In February 1980 the erection of the 320-foot lift span was started. The erection started in the middle of the span to permit the construction of the machinery house.

Floating out old Span #3 and floating in new span.

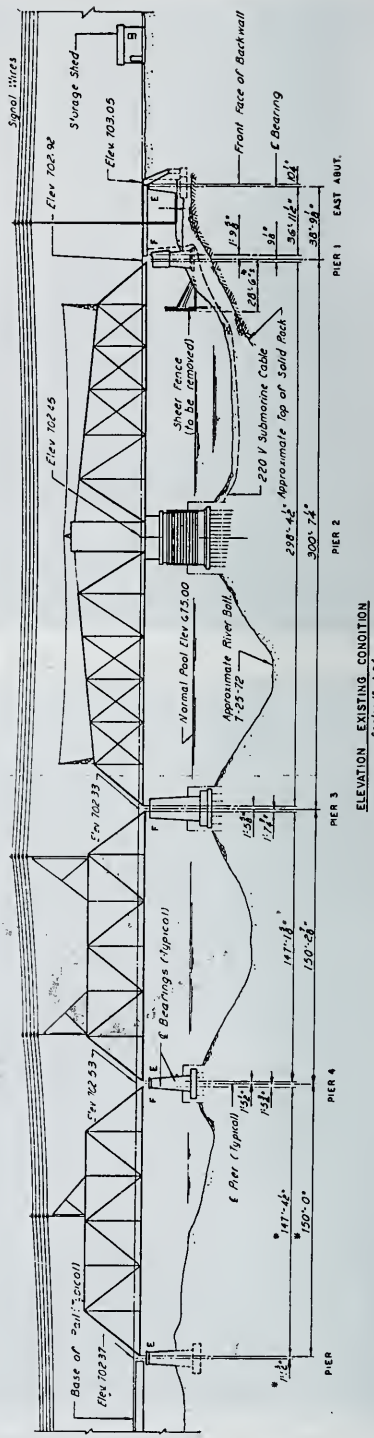
Floating out Span #3 to be dismantled for scrap.



Starting the assembly of the 320′ lift span. Work started in December 1979.

In February of 1980 the contractor proceeded to dismantle the upstream center pier protection crib. The timber crib has been removed and only the nose remains. Slides showed the machine house floor on the lift span; the continuation of the fabrication of the lift span indicating the machine house floor. When the upstream center pier protection crib was removed to facilitate the future float-in of the lift span it was necessary to provide temporary pier protection. These 3 barges were tied together to provide pier protection for the center pier. Slides showed the progress of the fabrication of the 320 foot lift span in June of 1980, including the lift span constructed on the high-strength rollers mounted on the construction platform; fabrication of the lift span, August 1980. Total weight of the lift span approximately 1,000 tons; a newly constructed pier-protection cell; and a barge moving through the existing channel.

Mr. Bessey also showed slides of a construction of a similar lift-span structure construction on the BN at Beardstown, Illinois.



Conclusion

The lift span weighs 1,996,480 lbs., or approximately 1,000 tons. The entire new structure which is 489 feet long has a total steel weight of 3,059,000 lbs., or approximately 15,030 tons. All the steel is A-588 weathering steel. In addition to the east and west tower spans and the new lift spans there are two 27-foot-diameter piers protection cells on the up stream side of the bridge. The lift span travel is approximately 36 feet which provides 60 feet vertical clearance above normal elevation. The lift span is designed to raise and lower in 1½ minutes. It is powered by two 30 horsepower motors and is equipped with an emergency gas engine.

This new structure will certainly be a vast improvement to river navigation and is certainly greatly beneficial to the railroad as it should provide a substantial reduction in maintenance cost and

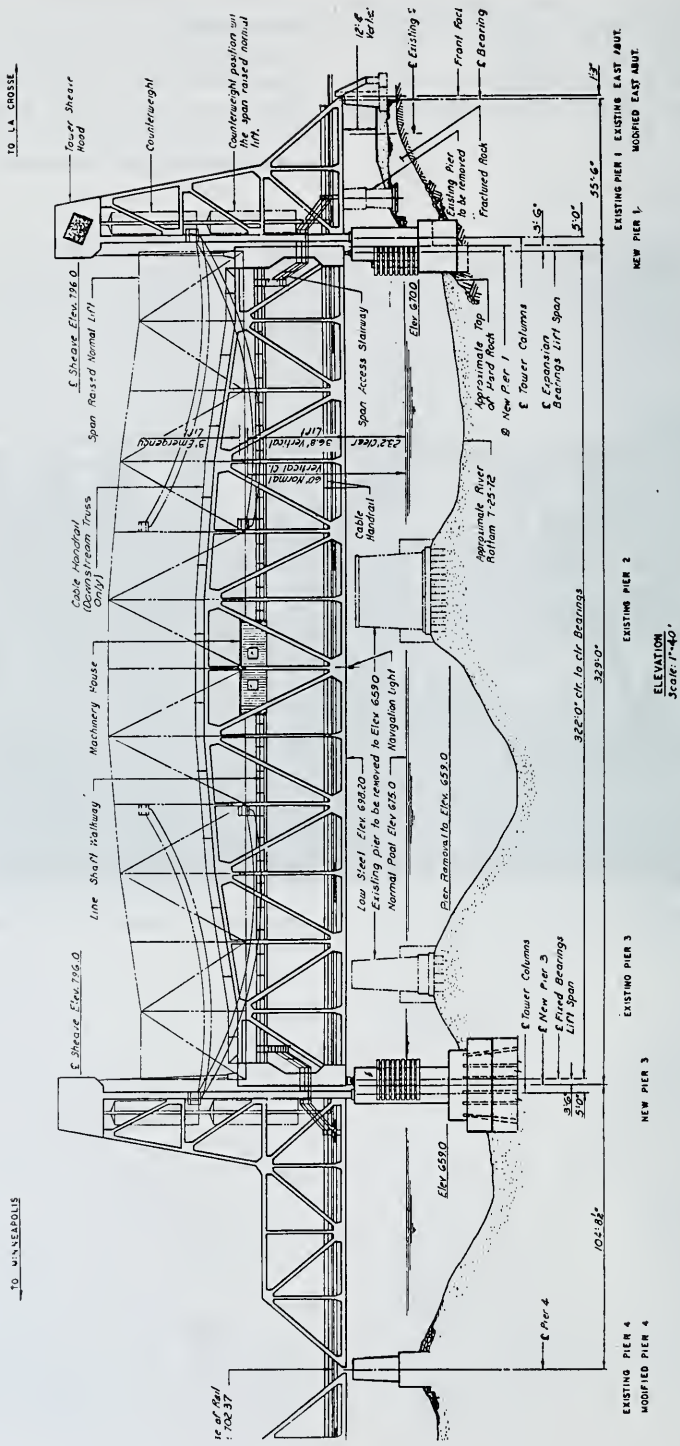
because of the 320-foot channel in the lift span, the bridge should be relatively free from boat damage.

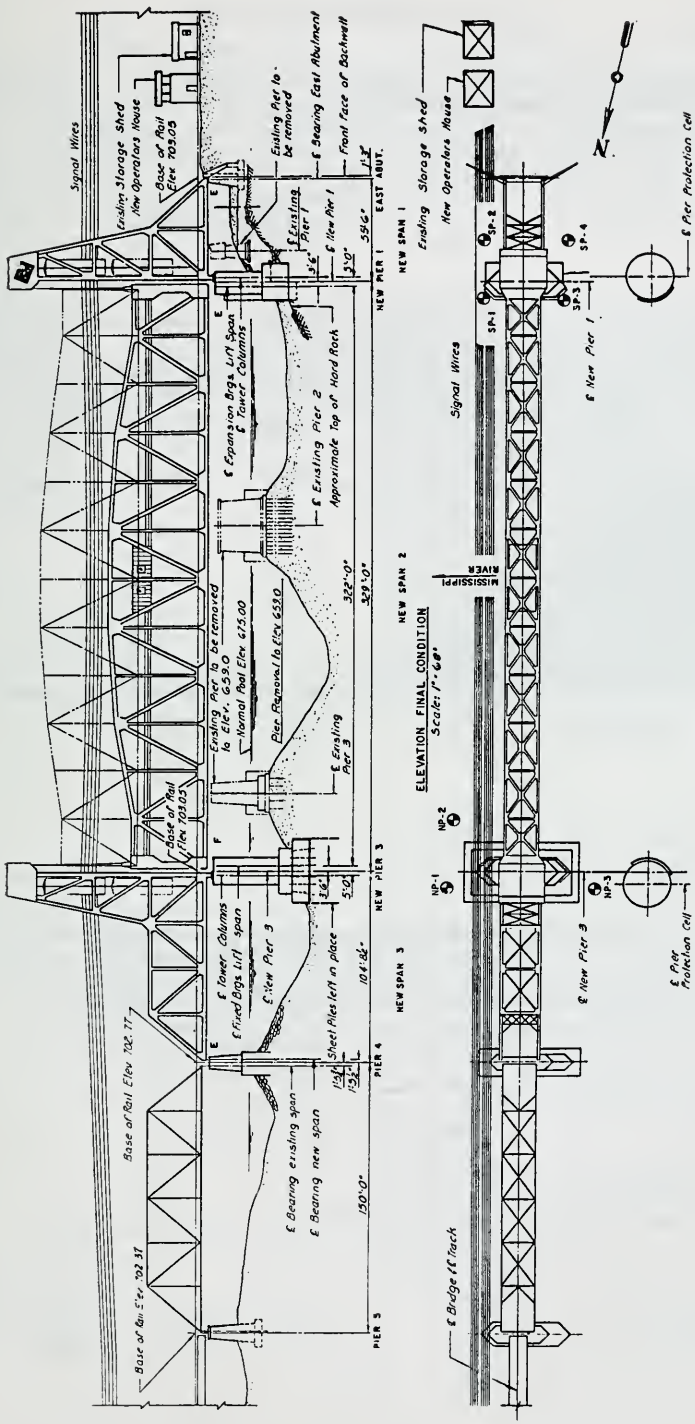
President Gould: Thank you for that fine report and the almost step-by-step slides.

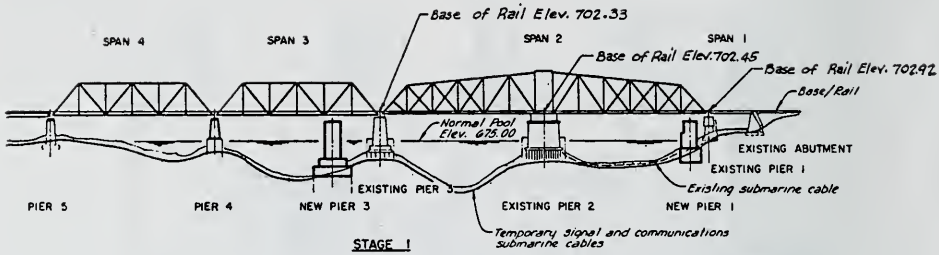
Mr. W. R. Hyma will introduce the next speaker.

Mr. Hyma introduces Mr. D. J. Lewis, Senior Designer, Illinois Central Gulf, Chicago, who gave the Report of Special Committee #2. (Mr. Lewis illustrated his talk with many slides.)

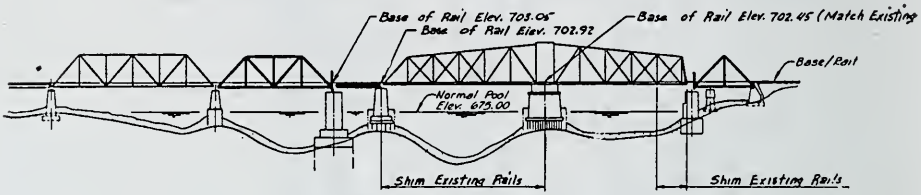
The 320′ lift span being assembled on the falsework. Picture taken in June 1980.


TO LA CROSSE
TO MINNEAPOLIS
Tower Sheave Hood
Counterweight
Counterweight position with the span raised normal lift.
Front Face
℄ Bearing
Existing Pier to be removed
Fractured Rock
℄ Sheave Elev. 796.0
Span Raised Normal Lift
Span Access Stairway
Elev. 670.0
Approximate Top of Hard Rock
℄ New Pier 1
℄ Tower Columns
℄ Expansion Bearings Lift Span
Approximate River Bottom T-25-12
Cable Handrail (Downstream Truss Only)
Cable Handrail
Machinery House
Line Shaft Walkway
Low Steel Elev. 698.20
Existing pier to be removed to Elev. 659.0
Normal Pool Elev. 675.0
Navigation Light
Pier Removal to Elev. 659.0
℄ Tower Columns
℄ New Pier 3
℄ Fixed Bearings Lift Span
Elev. 659.0
℄ Pier 4
EXISTING PIER 1
EXISTING EAST ABUT.
MODIFIED EAST ABUT.
NEW PIER 1
EXISTING PIER 2
EXISTING PIER 3
NEW PIER 3
EXISTING PIER 4
MODIFIED PIER 4
322'-0" ctr. to ctr. Bearings
329'-0"
104'-8½"
55'-6"
ELEVATION
Scale: 1"=40'

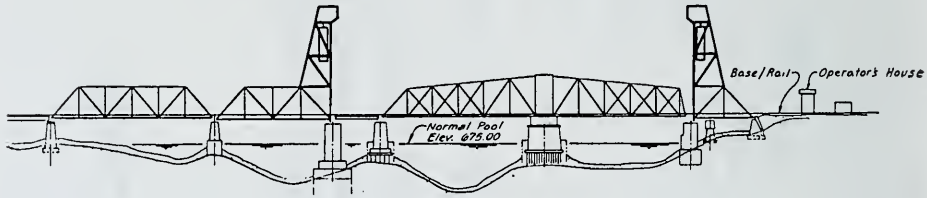

Signal Wires
Existing Storage Shed
New Operators House
Base of Rail Elev 703.03
Existing Pier to be removed
℄ Bearing East Abutment
Front Face of Backwall
EAST ABUT.
NEW PIER 1
NEW SPAN 1
℄ Existing Pier 1
℄ New Pier 1
℄ Expansion Bags Lift Span
℄ Tower Columns
℄ Existing Pier 2
Approximate Top of Hard Rock
NEW SPAN 2
MISSISSIPPI RIVER
Existing Pier to be removed to Elev. 659.0
Normal Rail Elev 675.00
Pier Removal to Elev 633.0
℄ Existing Pier 3
Base of Rail Elev 703.03
NEW PIER 3
NEW SPAN 3
℄ Tower Columns
℄ Fixed Bags Lift span
℄ New Pier 3
Sheet Piles left in place
PIER 4
℄ Bearing existing span
℄ Bearing new span
PIER 5
Base of Rail Elev 702.77
Base of Rail Elev 702.37
ELEVATION FINAL CONDITION
Scale: 1" = 60'
Existing Storage Shed
New Operators House
Signal Wires
℄ Pier Protection Cell
℄ New Pier 1
℄ New Pier 3
℄ Pier Protection Cell
℄ Bridge ℄ Track
PLAN FINAL CONDITION
Scale: 1" = 60'



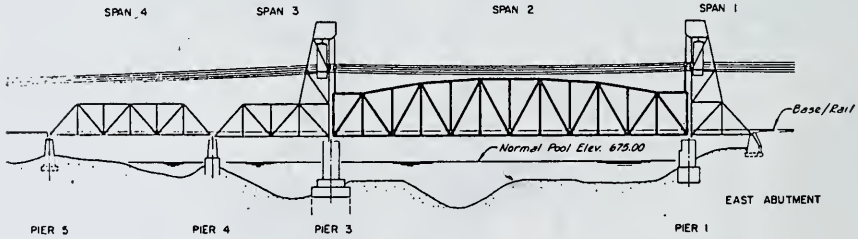
STAGE 1



STAGE 2



STAGE 3



STAGE 4

Maintenance of Movable Bridges

SPECIAL SUBJECT REPORT NO. 2

COMMITTEE—Don J. Lewis, *Chairman*, sr. st. design., I.C.G., Chicago, Ill.; D. K. Franz, *Vice-Chairman*, sr. br. insp., Milwaukee, Chicago, Ill.; W. J. Gunkle, sr. str. insp., ConRail, Philadelphia, Pa.; J. Budzelini, sr. str. desgn., I.C.G., Chicago, Ill.; J. Chambers, br. constr. engr., M.P., St. Louis, Mo.; J. R. Williams, sr. br. engr., T. K. Dyer, Inc., Chicago, Ill.; R. L. Cragg, pres., Earle Gear & Machine Co., Philadelphia, Pa.; H. Hahn, br. engr., C. & N.W., Chicago, Ill.; K. L. DeBlois, consultant, Envirodyne Engrs., Chicago, Ill.; J. W. Davidson, asst. dir. br. engrng., B.N., St. Paul, Minn.

Approximately four years ago Mr. Robert L. Cragg, President of Earle Gear & Machine Company, presented to the Association the forerunner of today's topic. The presentation "An Introduction to Movable Bridge Operating Machinery Inspection Procedures" enlightens us with a general overview of movable bridges and associated inspection procedures. In his closing, he urged us to "formulate, implement and support inspection programs which would benefit our respective railroads." For those of you who may be interested, his topic is printed in the proceedings of the 81st Annual Bridge & Building Conference held in Chicago in September 1976.

When asked to present this topic, I began with the idea of acquiring information from literature covering this subject. After making a very elaborate outline and researching different sources, two questions arose. Are these theoretical maintenance procedures really practiced and are not frequent inspections an integral part of maintenance?

What better source of practical information than from the people doing, or, supervising, the maintenance, the operator, bridge tender or local B & B supervisors. These are the people we all rely on for the day-to-day operation and maintenance of our bridges.

Before we get into the meat of this topic, we should first review a little background and general description of our movable bridges.

Movable bridges have been around since medieval times. Castle draw-spans

D. J. Lewis

and pontoon bridges are rudimentary movable bridges. These spans were cumbersome to operate but did serve their purpose. More recently metal structures were designed and improved. The railroads now operate over many bridges which were constructed around the turn of the century. These bridges were constructed for one purpose only; that is, to permit passage of vessels that would otherwise be blocked by insufficient vertical clearance when the structure is closed.

Any railroad which operates over a navigable river will probably have one or more movable spans that can be categorized as follows:

I. Swing Span —This type of span can either be a center - bearing

truss-swing span or a rim-bearing truss-swing span. Other types could be unbalanced swing-spans or thru-plate girder swing-spans.

II. Bascule Span —This type of span can either be a trunnion or a rolling lift type.

III. Vertical-Lift Span —This type of span can either be a Tower Drive or Span Drive.

A more unusual type is a cable span, but the exact category of a span does not really matter for each span is unique unto itself.

Frequency of Inspections

Each individual bridge has its own inspection and maintenance schedule which may range from a daily on-duty inspection or to a special problem inspection. The basic maintenance of movable bridges begins with the operator's daily inspection to ascertain if the bridge is in a good general operating condition. During his inspection he assesses that all ties, rails, rail locks, signals and other components are in satisfactory working order.

Some railroads have their divisional or area supervisors inspect certain bridges every six months while other railroads may inspect only once a year. One railroad informed me that it has underwater inspection of the movable bridge substructure performed every five years. If an operational problem occurs, a special inspection will generally be made to investigate, analyze and determine the apparent cause and then to recommend repairs of said problem.

In general, the daily inspections are not recorded but most railroads, if not all, usually keep a record of their yearly inspections. Special inspection reports are almost always retained. These regular inspections should alert the operator and his supervisor to any potential problem before it can render a bridge inoperable.

Here are some of the items which normally require frequent inspection and probable maintenance on our movable bridges. The next slides show worn babbitt or bushings in bearings, loose bearing bolts, worn gear teeth and loose or worn keys or keyways. A hesitation in or erratic operation of the machinery usually indicate one or more of these deficiencies exist in the drive train of the bridge. Other items to watch for are loose rack segments (which are most noticeable during acceleration and braking of the span), worn rollers and tread plates, worn pads or loose bolts on a rail-joint casting, signal interlocks (these must be properly aligned) and the constantly shot out or burned out navigation lights.

One item of particular importance on older swing spans is the clearance between the movable and fixed span. This change of clearance could be an indication of pier movement or span elongation. Recentering of the span on the pier or shrinking of the top chord are ways to alleviate future clearance restrictions.

Importance of Lubrication

Of all the maintenance performed, the most important is the lubrication of bearings and gears.

The time interval for the lubrication of each component varies greatly and is typified as shown in this table (Chart #1, Ball Bearing & Lubrication Internal) for the "lubrication and care" of a ball-bearing unit. The interval varies with respect to rotational speed, cleanliness and operating temperature ranges. One inherent problem is the lack of alternate lubricants when the recommended one is not available. These tables typify this problem.* First, (Chart #2) a table (Sheet L-1) of speed reducers indicating the Society of Automotive En-

* Tables supplied by the Earle Gear & Machine Company

gineers (SAE) and the American Gear Manufacturers Association (AGMA) lubricant designations for specific types of speed reducers. The next two tables (Chart #3 and #4) depict the variety of manufacturers' product designations. Similarly, this table (Chart #5) of a worm-gear speed-reducer (Sheet L-4 has a variety of lubricants (Chart #6 and #7).

These lubricants have a large variety of manufacturers' brand names and, more currently, may have different names, but they are still for the same basic lubricants. How many of you, if contacted by a local supervisor, could supply him with an acceptable alternate?

In addition to the application of the lubricant, the removal of old grease is also important. Old grease holds in particles and abrasives which, if not removed, can defeat the purpose of lubrication. Accumulated grease also makes inspection and further maintenance more difficult.

Now let us look at where these lubricants are used. Slides showed different movable parts which require lubrication including a typical set of reducing gears, noting the heavy texture of the lubricant on the gears and a link-chain connection which showed the drive machinery of the same bridge and which are lubricated differently.

A slide depicts a set of gears which are partially exposed to the elements and heavily greased. This heavier lubricant is used to protect and lubricate the exposed gears for a longer period of time. And the axial misalignment of the gears which results in only part of each tooth carrying the load.

Several types of gears may be in a drive shaft. A beveled pinion which engages the larger gear through the shaft to the . . .

Main pinion at the bottom of the shaft then to the segmental rack on which the span rotates. Excessive wear can appear at the upper portion of the rack teeth.

SEALMASTER BALL BEARING UNIT LUBRICATION AND CARE TABLE

CONDITIONS			
SPEED	TEMPERATURE	CLEANLINESS	GREASING INTERVAL
1000 RPM	Up to 120° F	Clean	6 to 12 Months
500 RPM	Up to 150° F	Clean	2 to 6 Months
1000 RPM	Up to 210° F	Clean	2 Weeks to 2 Months
1500 RPM	Over 210° F	Clean	Weekly
Any Speed	Up to 150° F	Dirty	1 Week to 1 Month
Any Speed	Over 150° F	Dirty	Daily to 2 Weeks
Any Speed	Any Temp.	Very Dirty	Daily to 2 Weeks
Any Speed	Any Temp.	Extreme Conditions	Daily to 2 Weeks

Sealmaster Ball Bearing - Engineering Data - May 1972

EARLE GEAR AND MACHINE COMPANY
SPEED REDUCERS

UNIT TYPE	UNIT SIZE (FROM DATE SHEETS)	AMBIENT TEMPERATURES* +15° to +60° F (-9 to +16 C)		+50° to +52° F (+10° to +52° C)	
		SAE	AGMA	SAE	AGMA
S	3-4	20	2	30	3
And	5 thru 8	20	2	40	4
SD	8-1/2 thru 12	30	3	40	4
D	3	20	2	30	3
And	4 thru 8	30	3	40	4
DD	8-1/2 thru 12	30	3	40	4
T	2-3-4	20	2	30	3
And	5 thru 8	30	3	40	4
TD	8-1/2 thru 12	40	4	50	5

* FOR LUBRICANT WHEN AMBIENT TEMPERATURES IS LOWER THAN +15° F SEE CHART ON PAGE L-3 UNDER COLD CLIMATE OIL.

S - SINGLE REDUCTION
SD - SINGLE REDUCTION WITH DIFFERENTIAL

D - DOUBLE REDUCTION
DD - DOUBLE REDUCTION WITH DIFFERENTIAL

T - TRIPLE REDUCTION
TD - TRIPLE REDUCTION WITH DIFFERENTIAL

THE EARLE GEAR & MACHINE COMPANY

SHEET L-1 June 2, 1972

The next slides showed a power unit with reduction gear.

The horizontal drive shaft to the beveled gears;

The vertical drive shaft to . . .

The two sets of drive gears. A bridge which has actually four sets of active drive gears and two sets of inactive drive gears (one shown on left of slide). With many pinions, broken teeth in the rack do not make this bridge inoperable.

Another point of lubrication is that of the truss pins which are lubricated through typical grease points.

Moving from the major bridge components requiring more periodic maintenance, let us now look at some of the items which are maintained on an "as required" basis. Examples of these are as follows:

I—Power Sources

Electrical motor power source; internal-combustion engine with manual operation of the transmission; a simple hand-operated wheel and of course, the old standby key.

II—Miscellaneous Span Components

Braking units. (It is the pad which requires replacement when worn.); the hydraulic lines have flexible hoses at a few points which eventually rot and

MINERAL OIL LUBRICANTS FOR DRIVES LISTED ON PAGE L-1

VISCOSITY SAE (AGMA) S.S.V. F 100° F (38° C.) MANUFACTURER	20 (2) 300-350 LUBRICANT	30 (3) 450-600 LUBRICANT	40 (4) 750-1000 LUBRICANT	50 (5) 1200-1500 LUBRICANT
ALEMITE	Hydraulic Oil HD #2	Hydraulic Oil HD #3	Hydraulic Oil HD #4	Hydraulic Oil HD #5
AMERICAN OIL CO.	American Ind. #31	American Ind. #51	American Ind. #95	American Ind. #150
ATLANTIC RICHFIELD CO.	DURO S-315	DURO S-465	DURO S-1000	DURO AW S-1500
CHEVRON OIL CO.	Chevron OC Turbine Oil 15	Chevron OC Turbine Oil 24	Chevron OC Turbine Oil 36	Chevron OC Turbine Oil 50
CITIES SERVICE OIL CO.	Pacemaker Oil #30	Pacemaker Oil #60	Pacemaker Oil #80	Pacemaker Oil #110
GULF OIL CORP.	Harmony 53	Harmony 69	Harmony 76	Harmony 97
HUMBLE OIL & REFINING CO. ENCO ESSO	Teresstic 52 Teresso 52	Teresstic 65 Teresso 65	Teresstic 85 Teresso 85	Nuto 113 Nuto 113
MOBILE OIL CO.	DTE Oil Heavy Med.	DTE Oil Extra Heavy	DTE Oil BB	DTE Oil AA
SHELL OIL CO.	Tellus Oil 33	Tellus Oil 41	Tellus Oil 72	Tellus Oil 75
SUN OIL CO.	Sunvis 754	Sunvis 764	Sunvis 775	Sunvis 7100
TEXACO INC.	Regal Pc (R&O)	Regal F (R&O)	Regal G (R&O)	Regal H (R&O)
UNION OIL OF CALF.	Turbine Oil 315	Turbine Oil 465	Turbine Oil 1000	Turbine Oil 1500

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SHEET L-2 JUNE 2, 1972

must be replaced; a buffer piston which is hydraulically lubricated; a span locking bar which requires lubrication as does the gearing, but only on an "as required basis"; wedge-type shoe which is lubricated whenever necessary; the rail locks which are opened by raising a tie upon which the rail is connected and when lowered, the rail slips into a channel for alignment.

III—Structural Components

Slides were shown of a damaged post reinforced by the use of two H-piles connected to the top and bottom chords; the concrete counterweight which is an integral part of all bascule spans; a well maintained deck which is also necessary for economic operation of any movable bridge; a span on an old stone pier which over the years requires masonry work of all joints or Gunite repair to the entire pier.

IV—Electrical/Signal Components

Slides of a typical control panel in which the bulbs or meters would be replaced when defective; the circuitry panel where fuses or components would be replaced as required; a sensing device; an electrical connection for those electrified railroads in the northeast corridor; a dwarf signal which represents all signals which must be maintained in connection with movable bridges; and a

COLD CLIMATE OIL FOR DRIVES LISTED ON SHEET L-1

AMBIENT TEMPERATURES - 15° to 60° F (-26° +60° C)	
MANUFACTURER	OIL RECOMMENDATION
ALEMITE	Super Heavy Duty 10W-30
AMERICAN OIL CO.	Amoco MV 10W-40
ATLANTIC RICHFIELD	DURO S-315 or DURO AW 5-315
CHEVRON OIL CO.	Chevron Supreme 10W30 or 20W40
CITIES SERVICE OIL	Extra Duty Circulating Oil 48 or C-610W-30
GULF OIL CORP.	Harmony 48 AW
HUMBLE OIL ENCO ESSO	NUTO H48 NUTO H48
MOBILE OIL CO.	Delvac Special 10W-30
SHELL OIL CO.	
SUN OIL CO.	
TEXACO, INC.	
UNION OIL OF CALIF.	Union Turbine Oil 215

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schematic showing the locations of typical U.S. Coast Guard navigation lights.

All of the electrical or signal devices are maintained by the appropriate personnel on an "as required" basis.

V—Protection

A slide showed the condition of a timber pile cluster and shear fence which were damaged which represents a large amount of repair work at many movable bridges and a damaged shear fence with a large steel sheet-pile and concrete-filled dolphin for protection to the bridge pier.

All of these items are really a "replace or repair as needed maintenance" with the exception of the internal combustion engine which should be maintained as if it were your own car. For example, oil change, battery, water, coolant, etc.

Painting of a span is inherent not only to movable spans but the surface condition of a movable bridge does affect its operation. For example, the south side of a swing span will absorb more heat, thus causing thermal expansion to deflect the span until it will not lock properly. On sunny days the bridge tender may have to rotate the span 180° and allow the expanded side to cool and contract to its proper alignment.

The next three slides had nothing to do with maintenance of a movable span but illustrated what problems a group of track people can cause:

A slide showing a smaller size of ballast which was used for a skin-lift on the approaches to this bridge. Instead of closing the hopper doors, they went right over the bridge; ballast fallen through the open deck onto the gears and resting on the segmental rack.

WORM GEAR SPEED REDUCERS

WORM CENTERS	WORM SPEED IN R.P.M.	LUBRICANT AGMA NO. AMBIENT TEMPERATURE*	
		+15° to +60° F	+50° to +125° F
Up to 6"	Up to 700	7 Comp.	8 Comp.
	Over 700	7 Comp.	8 Comp.
Over 6" and up to 12"	Up to 450	7 Comp.	8 Comp.
	Over 450	7 Comp.	7 Comp.
Over 12" and up to 18"	Up to 300	7 Comp.	8 Comp.
	Over 300	7 Comp.	7 Comp.
Over 18" and up to 24"	Up to 250	7 Comp.	8 Comp.
	Over 250	7 Comp.	7 Comp.
Over 24"	Up to 200	7 Comp.	8 Comp.
	Over 200	7 Comp.	7 Comp.

* FOR LOWER AMBIENT TEMPERATURES CONSULT LUBRICANT SUPPLIER. THE LUBRICANT SELECTED MUST HAVE A POUR POINT BELOW THE LOWEST TEMPERATURE EXPECTED.

NOTE:

A.G.M.A. LUBRICANT NO. 7 COMP. HAS VISCOSITY RANGE S.U.V. SEC. @ 210° F 125-150
A.G.M.A. LUBRICANT NO. 8 COMP. HAS VISCOSITY RANGE S.U.V. SEC. @ 210° F 150-190.

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Should Follow-through

Now, I realize some of you may have expected this presentation to supply you with information on how to maintain your movable bridges, but I do not profess, nor am I an expert in this field. I do, however, hope to re-emphasize the need for the regular follow-through-maintenance procedures on your respective movable bridges. I became quite aware of this need during a recent trip to one railroad's bridge and detected some potential problems still in their infancy. I observed loose bearing bolts and an extremely worn bushing which allowed the gear to vibrate excessively.

Another discovery, which I think should be passed on at this time, is the fact that, although many of the backup-power sources are tested, they are not tested completely. That is, the backup-power sources are not used to operate the movable bridges at the time of their testing. It is very easy to start and to operate the backup-power source without a service load, but when we really need this backup to operate the bridge we find the backup does not work either.

Now let us look at two special problems that involved different railroads. One railroad, during a routine inspection, discovered this particular problem, a broken tooth in the pinion gear which drives the cable drums of a 305′-8½″ double-track vertical-lift span. This missing tooth was in a critical position. It was the only fully meshed tooth on the pinion when the span was in the closed position. The first thing that had to be done was to remove the gear housing, then rotate the gear 180°. This allowed the bridge to operate normally while a new gear was being fabricated. The Coast Guard closed the river while the bridge was taken out of service for 10 hours. During this time the gear and

MANUFACTURER	AGMA NO. 7 COMP.	AGMA NO. 8 COMP.	BEARINGS ON ALL UNITS
ALEMITE	HD Gear Oil No. 7		HD Lithium No. 2
AMERICAN OIL CO.	Amer. Worm Gear Oil - 44155	Amer. Worm Gear Oil - 44155	Amolith Grease No. 2 EP
ATLANTIC RICHFIELD CO.	MODOC 135	MODOC 165	Litholine HEP 2 Grease
CHEVRON OIL CO.	Cylinder Oil 135 PX	Cylinder Oil 155 PX	DURA-LITH Grease EP-2
CITIES SERVICE OIL CO.	Citgo Cylinder Oil 140-5	Citgo Cylinder Oil 150-7	Citgo H-2 Grease or Citgo HEP-2
GULF OIL CO.	Gulf Senate 145-B	Gulf Senate 155	Gulfcrown Grease No. 2
HUMBLE OIL AND ENCO REFINING CO. ESSO	Cylesstic TK140 Cylesso TK140	Cylesstic TK180 Cylesso TK180	Lidok 2 Lidok 2
MOBIL OIL CO.	Mobil Cyl. 600 W	Mobil Super Cyl. 600 W	
SHELL OIL CO.	Valvata J78	Valvata J82	Alvania Grease EP-2
SUN OIL CO.			
TEXACO INC.	Honor Cyl. Oil	60 T Cyl. Oil	
UNION OIL OF CALF.	Union Worm Grease Lube 90 or Union Steaval A	Union Worm Grease Lube 140	Union Unoba EP-2

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shaft were removed, taken to a local shop, the new gear pressed on the drive shaft and raised for replacement in the bridge.

Another special problem was damage to the eye-bars of a bottom chord. This problem actually occurred in the fixed span adjacent to a 442′ swing span but could well have happened in the swing span proper. A procedure known as "heat shortening" was used to bring the bars back into proper alignment. The men clamped a specific bar, applied heat, inserted wooden wedges and then more heating until they began shortening the bar. This procedure was done at several locations with wedges inserted to keep individual bars apart. All the damaged bars were back to their original positions without a major expense for the replacement of those types of chords. A similar procedure can be used for elongated top-chord members.

Need Maintenance Manuals

Generally, all of us have a manufacturer's recommended maintenance manual for our new bridges in which will probably be a lubrication chart, as well as (Chart #8) instructions covering said maintenance. In addition, I recommend the United States Department of Transportation, Federal Highway Administration manual entitled "Bridge Inspector's Manual for Movable Bridges (IP 77-10) dated 1977." Newer bridges are general-

APPLICATION AND LUBRICATION

MANUFACTURER	BUSHINGS	COUPLINGS	OPEN GEARING	LOCK BAR GEARS	LOCK BAR GUIDES	LOCK BAR STEM
ALEMITE	General purpose light	Hl-Temp.No. 1	Gear Shield	MP Lithium No. 1	MP Lithium No. 2	Mp Lithium No. 2
AMERICAN	Amolith Grease No. 0 EP	Amolith Grease No. 1 EP	Amovis Lube No. 8-X	Amolith Grease No. 1 EP	Amolith Grease No. 1 EP	Amolith Grease No. 1 EP
ATLANTIC RICHFIELD	Litholine HEP 1	Litholine HEP 1	Onyx EP Fluid HS	Litholine HEP 1	Litholine HEP 1	Litholine HEP 1
CHEVRON OIL	Dura-Lith Grease EP-0	Dura-Lith Grease EP-1	Pinion Grease 100 CB or 250 CB	Dura-Lith Grease 1	Dura-Lith Grease 1	Dura-Lith Grease 1
CITIES SERVICE	Premium Lithium 1	HB-21	Compound LS-1	Premium Lithium 1	Premium Lithium 1	Premium Lithium 1
GULF OIL	Gulfcrown Grease EP-1	High Temp. Grease	Fluid Lubcote No. 3	Gulfcrown Grease EP-1	Gulfcrown Grease EP-1	Gulfcrown Grease EP-1
ESSO & ENCO	LIDOK EP-0	LIDOK EP-1	SURETT FLUID 50	LIDOK NO. 1	LIDOK NO. 1	LIDOK NO. 1
UNION OIL OF CALF.	Unoba EP-1	Unoba EP-1	Gearshield Heavy	Unoba EP-1	Unoba EP-1	Unoba EP-1

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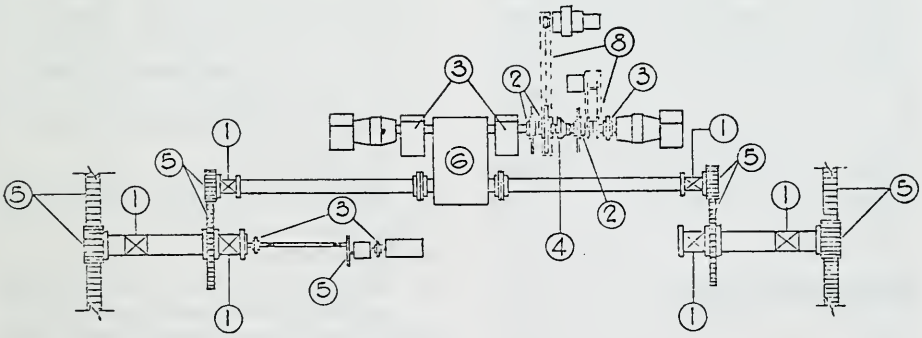
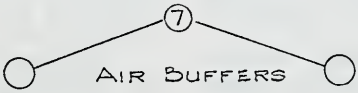


LUBRICATION PLAN



ly not our problem, although some of us do have problems with them. But rather, it is our older spans which do not have maintenance manuals and really need our attention. Some bridge tenders or B & B supervisors have taken it upon themselves and have written operation and maintenance instructions which are specifically for an individual bridge. These conscientious employees are the ones who, with these instructions and by word of mouth, educate our operators or maintenance gangs. *They are the real backbone of our bridge maintenance programs.*

Each railroad should help these people as much as possible by supplying charts or diagrams, showing points and frequency of lubrication, giving tables of acceptable alternate lubricants to supervisors, setting up periodic maintenance schedules for each bridge, and providing forms for each bridge which must be documented and returned to the divisional or general office for review. In the event some later mishap occurs, this information aids in the analysis and determination of necessary repairs. These charts and schedules will help the operator or bridge gang perform their maintenance more efficiently. In addition, it will also help these personnel in their overall education. I can only reiterate that more formalized maintenance procedures and documentation must be established. One thing we could all hope for, as noted to me by another railroad, "Don't Raise the Bridge, Lower the Ship." Since this probably is not going to happen, we must maintain our movable bridges as best we can.

Thank you.

Description of Slides

Slide No.

1. Mr. Robert L. Cragg's Topic—"An Introduction to Movable Bridge Operating Machinery Inspection Procedures."
2. Table indicating number of movable bridges built in the United States
3. View of tug and barges approaching a bridge
4. View of Center-Bearing Truss Swing-Span
5. View of Rim-Bearing Truss Swing-Span
6. View of Trunnion Bascule Span
7. View of Rolling Lift Bascule Span
8. View of Tower-Drive Vertical-Lift Span
9. View of Span-Drive Vertical-Lift Span
10. View of Cable Draw Span
11. Worn bushing in a bearing
12. Loose bearing bolts
13. Worn gear teeth
14. Worn key and keyway
15. Loose rack segment
16. Worn rollers and tread plates
17. Worn pad and loose bolts on rail-joint casting
18. Signal interlock
19. Navigation lights
20. Table of Ball-Bearing Lubrication Interval
21. Table of Speed-Reducer Gears (Sheet L-1)
22. Table of Manufacturer's designations (Sheet L-2)
23. Table of Manufacturer's designations (Sheet L-3)
24. Table of Worm-Gear Speed-Reducer (Sheet L-4)
25. Table of Manufacturer's designation (Sheet L-5)
26. Table of Manufacturer's designation (Sheet L-6)
27. Typical set of reduction gears
28. Different arrangement of reduction gears
29. Lubrication reservoir
30. Gears partially exposed to elements and having axial misalignment
31. Several types of gears in drive train
32. Main pinion gear and segmental rack
33. Segmental rack indicating an apparent proper fit with pinion gear
34. Rack and pinion of rolling-lift bascule span
35. Power unit with reduction gears
36. Horizontal drive shaft

Slide No.

37. Vertical drive shaft
38. 2 sets of drive gears and one set of inactive drive gears
39. Truss pin-lubrication points
40. Typical electric-power source
41. Internal-combustion engine as power source
42. Hand-operated wheel
43. Old style hand key
44. Braking units with pads indicated
45. Typical hydraulic hose line
46. Buffer piston
47. Span locking bar
48. Typical wedge-type shoe
49. Rail locks in raised position
50. Damaged post with 2 H-piles as replacement parts
51. Concrete counter weight
52. Well-maintained deck of span
53. Old stone pier
54. Typical electrical-control panel
55. Typical electrical-circuitry panel
56. Typical sensing device on bascule span
57. Typical electrification connection for Northeast Corridor
58. Dwarf signal
59. Navigation light schematic
60. Timber pile cluster and damaged shear fence
61. Steel sheet-pile and concrete dolphin with damaged shear fence
62. Auxiliary batteries for internal-combustion engine
63. Span requiring painting
64. Ballast across deck of T.P.G. swing span
65. Ballast on gears below deck
66. Ballast on segmental rack of span
67. Internal-combustion engine and generator as back-up power source
68. Broken tooth on pinion gear
69. Pinion gear on drive shaft
70. Gear housing removed and drive shaft exposed
71. Close-up of new gear
72. Drive shaft with new gear installed being raised to tower of vertical-lift span
73. Replacement of drive shaft
74. Replacement of drive shaft
75. New gear in operation

Slide No.

76. Bent eye-bar in bottom chord
77. Clamps on damaged bar
78. Heating and inserting wedges around bars
79. Shortening of heated bar with wrench
80. Different location of heating
81. Different location of wedges
82. Different location of wedges
83. Different location of wedges
84. Straightened eye-bars
85. Typical lubrication chart of newer span
86. Bridge Inspector's Manual for Movable Bridges
87. "Don't Raise The Bridge, Lower The Ship"
88. Well-maintained bridge-control room
89. Well-maintained gears in the control room
90. Well-maintained exposed chain drive and gears
91. Overall view of the well-maintained bridge

Lubrication Charts

A movable bridge is a machine, and to give the best service it must be kept:

(a) Properly lubricated
(b) Properly adjusted to take care of wear

Bearings must be handled with good judgment.

All cap and hold-down bolts at each bearing should be carefully inspected at least once each month to see that they have not worked loose. In doing this, note if shafts show perceptible movements in bearings during the operation of the bridge. Should this be discovered, the maintenance engineer should be notified, as it indicates that wear has taken place, and an adjustment of shims should be made. In adjusting shims, be *SURE* not to make bearing too tight.

Bearings not indicated by numbers are self lubricating and need no other method of lubrication from attendant.

Lubricate various parts of machinery

as indicated by circled *number* on *lubricating chart.*

1. Bearings:
   Application—Grease gun
   Lubricant—Texaco Multifak EP1
   Inspect weekly
2. Roller Bearings:
   Application—Grease gun
   Lubricant—Texaco Multifak EP1
   Inspect weekly
3. Falk Couplings
   (including brake wheel):
   Application—Grease gun
   Lubricant—Texaco Multifak EP1
   Inspect every six months
4. Shifting Assembly:
   Application—Brush
   Lubricant—Texaco Crater 5X fluid
   Inspect monthly
5. Gears—Racks & Pinions:
   Application—Brush
   Lubricant—Texaco Crater 5X fluid
   Inspect monthly
6. Falk Reducer:
   Unit should be serviced according to Falk Service Manuals #0810, 148-110, 143-110, 0800 and 1801. Unit holds approximately 23 gallons of AGMA 4 mineral oil. (Texaco Regal Oil G [R&O]). Unit must be filled to oil level indicated.
7. Buffer:
   The needle valve located at the top of the buffer cylinder will provide for a fine adjustment of the buffer piston rod.
   Adjust as necessary during the trial operation of span for a smooth cushioning of the span coming to rest.
   With span seated pour one pint of light cylinder oil (do not use detergent-type oil) through the thumb screw hole in the cylinder head. Check this every three months.
   Brush piston rod with grease and lubricate lower bushing with Texaco Multifak EP1 from points on ties. Check these points monthly.
   Oil: Texaco motor oil SAE 20-20W.
8. Silent Chain:
   Application—Brush
   Lubricant—Texaco Crater 5X fluid
   Inspect monthly
9. Rolling Faces—
   Track & Segmental Castings:
   Do Not Lubricate (teeth may be greased if binding occurs due to errors in tooth spacing).
   The end lock mechanism should be brushed lightly with Texaco MULTIFAK EP1 and oiled where necessary to insure smooth operation. Inspect monthly.

President Gould: Thank you for your fine report which shows much work on the part of this committee. Mr. Hyma will now introduce our next speaker.

Mr. Hyma: Our next speaker is D. R. Ladner, Assistant Engineer, Chicago & North Western, Iowa Division of Boone, Iowa, who will give the report of Special Committee #1.

Bridge Inspection — Procedures and Records

SPECIAL SUBJECT REPORT NO. 1

COMMITTEE—D. R. LADNER, *Chairman*, asst. engr. CNW Transportation Company, Boone, Iowa; B. T. BURNS, *Vice Chairman*, steel br. insp., A.T.S.F. Railway Company, Topeka, Kansas; D. A. BESSEY, asst. ch. engr. strs., CMStP&P Railroad Company, Chicago, Illinois; M. P. BHALANKIA, des. & const. engr., P&LE Railroad Company, Pittsburgh, Pennsylvania; W. E. BRANKENSIEK, asst. ch. engr., Missouri Pacific Railroad Company, St. Louis, Missouri; N. D. BRYANT, sr. br. engr., S.L.S.F. Railway Company, Springfield, Missouri; J. W. DAVIDSON, asst. dir. br. engr., BN Railroad, St. Paul, Minnesota; N. E. WHITNEY, *br. engr.*, ICG Railroad, Chicago, Illinois; E. B. DOBRANETSKI, engr. fac. & str., B&LE Railroad, Greenville, Pennsylvania; J. J. HORNEY, asst. B&B supv., Union Pacific Railroad Company, Omaha, Nebraska; D. C. KNUTH, Clark Dietz Associates, Chicago, Illinois; P. LONGIOTTI, asst. str. insp., B&LE Railroad, Greenville, Pennsylvania; R. F. MCGUIRE, Osmose Company, Madison, Wisconsin; R. D. PATTON, B&B proj. supvr., Southern, Chattanooga, Tennessee; J. R. SHEPHERD, B&B supvr., Southern, Columbia, South Carolina.

Bridge inspections, performed on a regular basis, are essential to ensure the safety of rail traffic. All railroad bridges should be inspected at least once a year, with more frequent routine inspections necessary due to the age or condition of the bridge. In addition to regular inspections, it may be necessary to perform special inspections following such natural disasters as fires, floods and earthquakes, or following a derailment. Underwater inspections are performed on an as-required-basis to check for scouring or undermining of piers and abutments. Such inspections are usually done by a consultant. Inspection methods should be non-destructive. Bridges should be inspected under load if possible.

When making an inspection, such factors as line speed, load limit, unit train movement and traffic density should be considered by the inspector. Bridges in high-speed or unit-train territory deteriorate more quickly than branch-line bridges.

D. R. Ladner

Report is Filled in at Bridge Site

The inspection report is filled out at the bridge at the time of the inspection, noting sufficient information to fully describe the structure and its condition. Any serious deficiencies that may interfere with normal train operations should be immediately reported to the proper authority. Conditions requiring the removal of a bridge from service must be properly protected by flagging, etc. Any changes in the condition of the structure since the last inspection are noted. Since we compare the most recent inspection report to those made previously, it is important to standardize the format of the inspection report and the inspection procedures.

Various types of inspection forms are in use today ranging from a note pad

containing a brief description of the bridge to a check-off type form. The latter tends to produce a more complete and uniform inspection. An erection-diagram-type schematic is used by some railroads to note the location of deficiencies.

The inspection report is used to help determine maintenance requirements and to make recommendations for bridge renewals.

Bridge inspections can be performed by a consultant, the division B & B supervisor and/or a system bridge inspector, A two-man team usually works best. A qualified inspector should have a good working knowledge of bridge construction and repair procedures. Knowledge of bridge design is helpful. Division maintenance gangs and system construction gangs are good sources of competent bridgemen.

The inspector should be agile and curious. He should be thorough and critical. Since most inspection is visual, it is necessary for the inspector to gain access to all members of a structure. Those members requiring the closest inspection are often least accessible. Inspection ladders, walkways, handrails and movable scaffolds are widely used to facilitate the inspection, making the job safer for the inspector.

Learn by Inspecting

The new inspector may receive some instruction on bridge inspection techniques; but most of his training is on the job. An experienced inspector usually makes a good teacher. The best way to learn how to inspect bridges is to go out with a competent inspector and start inspecting. The inspector must learn to recognize serious conditions as opposed to those of a cosmetic nature. It may take several years of training to produce a good inspector.

The inspector uses various special equipment. A motor car or hy-rail vehicle is useful in gaining access to the bridge. Tapes and rulers, flashlights, timber inspection bars, chipping hammers, scrapers, outside calipers, chalk or keel, safety belts, ladders, scaffolds, hip boots, levels, plumb bobs, dye penetrant, portable drills and increment borers are commonly used by the inspector. A camera is an absolute necessity. An inspection mirror with a swivel head is useful for viewing otherwise inaccessible connections. Other special equipment—such as boats and hydraulic buckets—are obtained on an as-required basis.

Basic Bridge Types

Several basic types of railroad bridges include: timber trestles, both open-decked and ballasted; conventional and laminated timber; concrete bridges, conventionally reinforced and pre-stressed; steel bridges, including rolled beams, deck and thru-plate girders, "Pony," thru and deck trusses; arches and culverts—(although a difference of opinion exists as to when an arch or culvert is large enough to be considered a bridge); overhead highway bridges and other structures.

Timber bridges make up over 50% of the railroad bridges on many railroads today. Nearly all of the timber bridges are treated. Many were constructed in the 1920's and '30's and are still in service today. The 100-ton cars have produced maintenance problems requiring more frequent inspections.

Timber Structures

Timber bents and piers should be sounded with an inspection bar just above the ground line or water line, at longitudinal and lateral bracing connections, at sills in framed bents and directly below the cap where water may enter from above. A clear ringing sound indicates good, solid timber. A very dull thud indicates a large void. A portable drill may be used to determine the size of the void. Piles should be checked visually for splits, checks and shakes. Piles in the waterway should be checked for ice flow damage, plumbness, evidence of scouring and the buildup of drift which can be a fire hazard.

Caps are inspected visually for checking and bulging. They are sounded at each stringer chord to check for voids. The bottom of the cap is checked for crushing or penetration by the piles.

Stringers are inspected for crushing at bearings, loose hardware, checking, horizontal shear, excessive deflection and tension cracks.

The decking and ballast curbs are inspected for decay and proper drainage. Bridge ties on open-deck bridges are inspected for proper alignment, checking and crushing. Deck fastenings should be in place and tight.

The line and surface of the track on the bridge and adjacent track should be noted. Slight imperfections in track geometry have little significance on light-density branch lines. However, these imperfections are punctuated on high-speed main lines and accelerate the wear of the bridge.

Steel Structures

Concrete abutments are checked for tipping of the backwalls and movement of the wingwalls. The bridge seats are checked for cracking and spalling. They should be clean and level. Proper clearance between the span and the backwall should be provided to allow for the proper expansion of the span. The face of the abutment should be checked for vertical cracks which may be caused by settlement of the foundation piling or grillage. The length and width of the cracks should be noted and marked with paint or keel. Subsequent inspections should note any changes in the length or width of the cracks.

Concrete piers should be checked for ice-flow damage, tipping due to undermining or slippage of the embankment and disintegration at the waterline or ground line. Concrete piles and caps should be checked for plumbness and cracking.

Masonry arches, piers and abutments are inspected for plumbness, bulging, ice damage, loose or missing mortar, vegetation in the joints, settlement, spalled, cracked, loose or missing stones.

Concrete girders and slabs are inspected for spalling, leaching and flexural cracks in the tension zone. Cracks in the bottom of pre-stressed girders or slabs indicate a serious overloading of the structure. Expansion bearings should be clean and in proper working order.

Waterproofing and drains should be in good repair to prevent freeze-thaw damage to the structure.

Corrosion at Connections

Steel-pile bents are inspected for ice damage and rust. The base of the piles and bracing connections are particularly susceptible to corrosion as debris collects at these points retaining moisture which promotes rust. A chipping hammer is used to determine the extent of the corrosion.

Steel pier caps are checked for rotation caused by pier movement. Welds should be inspected for cracks. Webs and stiffeners are checked for corrosion and buckling caused by overloading.

Bearings should be free of debris and in proper alignment. Rockers, expansion rollers and shoes should be checked for cracks and corrosion. Rollers should be properly greased. Anchor bolts should be in place and tight.

Rolled beams and deck girders should be checked for corrosion at bearings, top flange areas, the top surface of the bottom flanges where debris can hold moisture, diaphragms and lateral bracing connections. Calipers should be used to determine the loss of section. The location of the loss of section should be carefully noted along with sketches or pictures to help determine what effect the loss will have on the load-carrying capacity of the bridge.

Thru-girders and trusses should be checked for corrosion of the stringers and floor beams. Timber ballast-decked structures retain moisture at the top flange interface increasing the chances for corrosion at this point. Connections should be given special attention, checking for loose or missing rivets or bolts and signs of movement under load. Seated connections should be checked

SANTA FE RY. CO.
INSPECTION RECORD—TIMBER TRESTLE BRIDGE

Division

Year of Inspection

Month & Year Last Inspection

District: ..... Bridge: ST DT EW WW..... Bridge No: .....

Trestle Type: ..... Date: ..... Panels: .....

Alignment: Tangent ..... Degree Curve. B/R to Ground, Ft: .....

Speed over Bridge: ..... MPH Stream: ..... Trains Per Day: .....

CHECK LIST, CONSISTS, MINOR DEFECTS, REMARKS

Mark for Items: O which do not exist; X calling for remarks or work; √ OK, no work.

..... 1. Rails (SGR) ..... # (RRail) ..... #
..... 2. Track, or Line & Surface (L&S)
..... 3. Open Deck (OD)
..... a. Ties T1 T2 T3 .....
..... b. Guard Timbers (GT) .....
..... 4. Ballast Deck (BD)
..... a. Bal Curbs (BC) .....
..... b. Bal Depth EW ..... " WW ..... "
..... 5. Walk and/or Handrail (W&HR) .....
..... 6. Deck Hardware (Hdw) .....
..... 7. Chord Tin (CT) Cap Tin .....
..... 8. Strgs TR EW ..... WW .....
√ a. No. & Size Per Panel .....
..... b. Treated Untreated .....
..... c. Rolling Spreading .....
..... d. Helpers (HS) .....
..... 9. Caps (C) .....
..... 10. Dump Planks (DP) .....

..... 11. Shims (Sh) .....
√ 12. Piles (P), Bents (B). Bore .....
√ a. No. Per Bent .....
√ b. Bent Date: EW ..... WW .....
..... c. Frame Bents (FB) .....
..... d. Posted Piles (P) .....
..... e. Helper Posts (HP) .....
..... 13. Sash, Sway Bracing (US) (SB) (LS) .....
..... 14. Longitudinal Bracing (LB) .....
..... 15. Bent Hardware (Hdw) .....
..... 16. Vegetation Under Bridge .....
..... 17. Trestle Under Traffic .....
..... 18. Scour Under Bridge, Rip Rap (RRap) .....
..... 19. Head of Banks (HB) .....
..... 20. Renew Bridge .....
..... 21. .....
..... 22. .....
..... 23. .....

No.	DEFECTS TO BE KEPT UNDER OBSERVATION & REMARKS

DIVISION BRIDGE GANG WORK (DBG) ("C", "B", "A", Priorities)

Work Required	Material Required	Priority

Form 1940 Standard

THE A.T. & S.F. RY. CO.

CONCRETE BRIDGE INSPECTION RECORD

Division _____

District _____

Bridge No. _____

At Between Station(s): _____ State: _____ Tracks: _____

Waterway Roadway RR: _____ Center Ht: _____ Clearance _____

Approaches: _____ Alignment: Tangent Spiral _____ Curve

Concrete Spans: _____

Substructure: _____

Maintenance Responsibility: ATSF_____ Other (Specify) _____

CHECK LIST: ✓ — SATISFACTORY: X — CONDITION REQUIRING COMMENTS O — NOT APPLICABLE

DATE OF INSPECTION								DATE OF INSPECTION							
	Year								Year						
	Month								Month						
	Date								Date						
TRACK, (a- Approaches, b-Span)								14. Bearings							
1. Line and Surface								SUBSTRUCTURE							
2. Running Rail (#)								15. Bridge Seat, Caps							
3. Anchorage : Fastenings								16. Pedestals, Blocking							
4. Guard Rail (#)								17. Abutments, Parapets, Wing Walls, Dumps							
5. Ties (Track, Bridge)								18. Piers, Bents							
6. Ballast								19. Scour, Riprap							
SPAN								GENERAL							
7. Main Beams/Slabs								20. Clearances							
8. Deck								21. Channel, Waterway, Drift							
9. Curb								22. Utilities, Attachments							
10. Walk and/or handrail								23. Inspection Facilities							
11. Waterproofing								24. Damage-Rail, Highway, Water Traffic							
12. Apron Plates								25. Observation Under Traffic							
13. Hardware								26. Inspected by:							

ITEM	COMMENTS	PRIORITY	GANG	DONE

Inspection Results Posted: Original Record_____ Work Program _____ Sheet ____ of ____

Form 1939 Standard

A.T. & S.F. RY. CO.

STEEL BRIDGE INSPECTION RECORD

Division _____

District _____

Bridge No. _____

Between Station(s): _____ State: _____ Tracks: _____

Waterway Roadway RR: _____ Center Ht: _____ Clearance: _____

Approaches: _____ Alignment: Tangent Spiral _____ Curve

Steel Spans: _____

Substructure: _____

Maintenance Responsibility: ATSF _____ Other (Specify) _____ Last SBF Insp: _____

CHECK LIST: √ – Satisfactory; X – Condition Requiring Comments; O – Not Applicable

DATE OF INSPECTION	Year											
	Month/Date											
TRACK (a - Approaches, b - Steel Span)							15. Truss Members					
1. Line and Surface							a. Chords, End Posts					
2. Running Rail (#)							b. Web Members – Vertical, Diagonal					
3. Anchorage : Fastenings							c. Pins, Connections, Splices					
4. Guard Rail (#)							d. Sway, Portal Bracing, Brackets					
5. Ties (Track, Bridge)							16. Lateral Bracing					
6. Ballast							17. Bearings					
DECK							SUBSTRUCTURE					
7. Deck (Timber, Steel, Concrete)							18. Bridge Seat, Caps					
8. Curb							19. Pedestals, Blocking					
9. Waterproofing							20. Abutments, Parapets, Wing Walls					
10. Apron Plates							21. Piers, Bents, Towers					
11. Hardware							22. Scour, Riprap					
12. Walk and/or Handrail							GENERAL					
SPAN							23. Paint, Protective Coating					
13. Floor System							24. Clearances					
a. Floorbeams (Flanges, Webs)							25. Channel, Waterway, Drift					
b. Stringers (Flanges, Webs)							26. Utilities, Attachments					
c. Bracing, Diaphragms, Connections							27. Inspection Facilities					
14. Main Beams/Girders							28. Damage – Rail, Highway, Water Traffic					
a. Flanges, Web, Stiffeners, Splices							29. Observation Under Traffic					
b. Cross Frames, Diaphragms, Brackets							30 Inspected by					

ITEM	COMMENTS	PRIORITY	GANG	DONE

Inspection Results Posted Original Record _____ Work Program _____ Sheet ____ of _____

Form 1941 Standard

THE A.T. & S.F. RY. CO.

OVERHEAD BRIDGE INSPECTION RECORD

Division _____

District _____

Bridge No. _____

At Between Station(s): _____ State _____

Roadway Walkway Pipeline _____ Center Ht: _____ Clearance: _____

Tracks: _____ Track Alignment: Tangent Spiral _____ Curve

Spans: _____ Substructure: _____

Owned by: ATSF _____ Other (Specify) _____ Maintenance Responsibility: ATSF _____ Other (Specify) _____

Inspected by: ATSF _____ Other (Specify) _____ Last SBF Insp: _____

CHECK LIST: ✓ — SATISFACTORY: X — CONDITION REQUIRING COMMENTS: O — NOT APPLICABLE

DATE OF INSPECTION	Year						DATE OF INSPECTION	Year					
	Month							Month					
	Date							Date					
DECK							10. Lateral Bracing						
1. Wearing Surface							11. Bearings						
2. Deck (Timber, Steel, Concrete)							SUBSTRUCTURE						
3. Curb							12. Bridge, Seat, Caps						
4. Drain							13. Pedestals, Blocking						
5. Expansion Joints or Devices							14. Abutments, Parapets, Wing Walls						
6. Walk, Handrail or Railing							15. Piers, Bents, Towers						
SPAN (Timber, Steel, Concrete)							16. Erosion, Settlement						
7. Floor System							GENERAL						
a. Floorbeams							17. Paint, Protective Coating						
b. Stringers							18. Clearances						
c. Bracing, Diaphragms, Connections							19. Utilities, Attachments						
8. Main Beams/Girders							20. Inspection Facilities						
9. Truss Members							21. Damage — Rail, Highway, Traffic						
a. Chords, End Posts							22. Observation Under Traffic						
b. Web Members - Vertical, Diagonal							23. Blast Plates						
c. Pins, Connections, Splices							24. Other (Specify)						
d. Sway, Portal Bracing, Brackets							25. Inspected by:						

ITEM	COMMENTS	PRIORITY	GANG	DONE

Inspection Results Posted: Original Record _____ Work Program _____ Sheet ____ of ____

SANTA FE RY. CO.
INSPECTION RECORD—CULVERT

Division

Year of Inspection

Month & Year Last Inspection

District: _____ Track: ST DT EW WW _____ Bridge No: _____

Stream Name: _____ Culvert Type: _____

Year Built:				
Year Extended:				
Consists:				
Number of Openings:				
Width (Horizontal - Ft):				
Height (Bench Wall - Ft):				CONDITION AND REMARKS
Length (Nearest Full Ft):				
Footing (Stone or Conc):				
Bench Walls (Stone or Conc):				
Arch Ring (Brick or Conc):				
Headwalls (Stone or Conc):				
Wingwalls (Stone or Conc):				
Floor (Unpaved or Paved):				

B/R to Flow Line (Ft): _____

RRap (Rt or Lt End): _____

Scour: _____

DEFECTS TO BE KEPT UNDER OBSERVATION & REMARKS

DIVISION BRIDGE GANG WORK (DBG) ("C", "B", "A", Priorities)

Work Required	Material Required	Priority

SOUTHERN RAILWAY COMPANY
MASONRY INSPECTION

DIVISION	MILEPOST
INSPECTOR	DATE

EXPLANATION AND REMARKS:

TUNNELS

KIND:
- [ ] Brick
- [ ] Stone
- [ ] Concrete
- [ ] Timber
- [ ] Metal
- [ ] Natural
- [ ] Combination

Yes	No	
		Portal at one end?
		Portals at both ends?
		Rock or earth spilling over portals?
		Scaling required at portals or approach cuts?
		Washing evident at portals or approach cuts?
		Portal pulling away from tunnel at either end?
		Lining bulging, cracking, flaking? (Explain)
		(If unlined) Any loose rock?
		Water seeping through roof or walls?
		Track in proper line and surface?
		Portal or lining material sound? (Explain)
		Side ditches open?

RETAINING WALLS

KIND:
- [ ] Masonry
- [ ] Concrete
- [ ] Brick
- [ ] Concrete Crib.
- [ ] Metal Crib.
- [ ] Timber Crib.

Yes	No	
		Settling, leaning or sliding?
		Fill spilling over wall?
		Washing or scour?
		Embankment draining properly?
		Weep holes open?
		Water draining away from wall properly?
		Material flaking or deteriorating?
		(If cribwall) Members broken or misaligned?
		Fill stable behind wall (or in bins)?
		Has wall been raised? _____ ft.

CULVERTS

KIND:
- [ ] Pipe
- [ ] Box
- [ ] Arch

MATERIAL
- [ ] Brick
- [ ] Stone
- [ ] Concrete
- [ ] Metal
- [ ] Timber
- [ ] Combination

Yes	No	
		Channel open upstream?
		Channel open downstream?
		Culvert open?
		Settlement or shifting?
		Culvert material sound? (Explain)
		Cracks or open joints?

Diameter / Height / Width

INLET END Yes	INLET END No		OUTLET END Yes	OUTLET END No
		Headwalls?		
		Fill spilling over headwalls?		
		Headwalls pulling away from culvert?		
		Culvert ends undermined?		

Lengths* _____ ft _____ ft _____ ft _____ ft (Total)

Kind _____ _____ _____

Size _____ _____ _____

*- Measure from inlet end.

FORM 1201 (REVISED 9/71)

SOUTHERN RAILWAY COMPANY
TRESTLE INSPECTION

DIVISION	MILEPOST
INSPECTOR	DATE

TYPE TRESTLE	NO. OF TRACKS	PREVIOUS HIGH WATER
☐ CONCRETE		☐ Above Base of Rail _____ Inches
☐ STEEL B.D. ☐	B/R To T/CAP _____ Inches	
☐ TIMBER O.D. ☐		☐ Below Base of Rail _____ Inches

Yes	No	
		Are 4 white bridge marker posts in place?
		Track surfaced properly at ends?
		Is track gauge satisfactory?
		Approaches in good alignment?
		Structure in good surface?
		Does grade line of trestle match approaches properly?
		Structure in good alignment?
		Does trestle have backwall?
		Backwall in good condition?
		Ballast guards high enough?
		All ballast leaks stopped?
		Floor in good condition?
		Ties in good condition?
		Deck coating in good condition?
		Walkways and railings sound?
		Are stringers in good condition?
		Are stringer diaphragms tight?
		Are stringer chord bolts tight?
		Do stringers have full bearing on all caps?
		Are stringer shims in good condition?
		Is structure grease or paint surface good?
		Are all anchor bolts or drift bolts in place?

Yes	No	
		Is structure free of grass or undergrowth?
		Is trestle profile correct?
		Is bent bracing sound and tightly fastened?
		Do piles fit tightly under caps?
		Are all caps in sound condition?
		Are cap plate welds sound?
		Are bents tight, without evidence of pumping or churning?
		Are piles or posts sound?
		Are bents plumb?
		Is trestle free of drift?
		Is blocking sound?
		Is blocking undermined by washing or erosion?
		Any immediate repairs needed?
		*Any vehicular road under trestle?
		*Any stock passage under trestle?

*- If YES, to these items, advise in REMARKS as to character and history of such use.

NOTE: Line out items which do not apply. Describe defects or unusual conditions in REMARKS.

EXPLANATION AND REMARKS:

SOUTHERN RAILWAY COMPANY
STEEL BRIDGE INSPECTION

DIVISION	MILEPOST
INSPECTOR	DATE

NO.OF TRACKS _____ NO.OF SPANS ON THIS REPORT _____ B.D. O.D.

Yes	No		Yes	No	
		Track surfaced on approaches?			Bridge seats clean?
		Approaches in good alignment?			Bridge seats sound?
		Structure in good alignment?			Anchor bolts in place?
		Structure in good surface?			Expansion bearings working?
		Deck/Slab good?			Clearance OK at expansion ends?
		Ballast guards high enough?			Fixed bearings properly set?
		Ties in good condition?			Sole plates in good surface, without need of grouting?
		Hook bolts working properly?			Masonry in sound condition?
		Walkways and railings sound?			Morter joints tight?
		Truss members straight and undamaged?			Concrete free of serious cracks?
		Eyebars tight?			Concrete free of serious spalling, or exposed reinforcing?
		All bolts and rivets in place and tight?			Piers and footings sound, without evidence of settlement?
		Pin nuts striped?			Are pile bents sound?
		Pin holes in ends of members not enlarged?			Are cap welds OK?
		All members, including hangers, free of cracks?			Is pile bracing OK?
		End connection angles free of cracks?			Is embankment free of serious erosion?
		Sway or longitudinal bracing OK?			Is structure free of serious undergrowth?
		End stiffeners in good condition?			Is structure free of drift?
		Are members free of serious rust damage?			Can repairs be avoided before next inspection?
		Paint or grease in good condition?			

NOTE: Line out items which do not apply. Describe defects or unusual conditions in REMARKS column.

EXPLANATION AND REMARKS:

THE PITTSBURGH & LAKE ERIE RAILROAD COMPANY

NW 203 Rev.

BRIDGE INSPECTION REPORT

DIV. _____ BRANCH _____ BRIDGE NO. _____

LOCATION _____ O.N. _____ U.G. _____

TYPE OF BRIDGE _____ NO. SPANS _____ SPAN NO. _____ LENGTH _____

NO. TRACKS _____ TRACK NO. _____

WATERWAY _____ (TANGENT _____

ROADWAY _____ TRACK ALIGNMENT (CURVE _____

OTHER _____

DATE LAST INSPECTION _____ DATE THIS INSPECTION _____

NOTE: USE SEPARATE SHEET FOR EACH SPAN FOR SPECIAL CONDITIONS.

ITEM NO.	GENERAL	A	B	R
1	Paint ( ) yr			
2	Clearance Signs			
3	Highway minimum clearance ( )			
4	PC Insignia			
5	Load Limit Signs ( ) Tons			
6	Fire Protection			
7	Action under trains			
8	Approach track			
9	Track on bridge			
	STREAM CONDITIONS	**A**	**B**	**R**
10	Paving through bridges			
11	Sheet piling protection			
12	Scour (Distance top of rail to bed of stream _____)			
13	Rip rap			
14	Fender System			
	MASONRY	**A**	**B**	**R**
15	Abutment N or E			
16	Abutment S or W			
17	Backwalls			
18	Wingwalls			
19	Timber back walls			
20	Piers			
21	Pedestals			
22	Arches			
23	Parapet Walls			
24	Pointing			

ITEM NO.	MASONRY (CONT.)	A	B	R
25	Previous Gunite			
26	Slab			
27	Cleanliness			
	GIRDERS, BEAMS OR TRUSSES	**A**	**B**	**R**
28	Top Flg or Chord			
29	Bot Flg or Chord			
30	Bearing Stiffs			
31	Web or Diagnls			
32	Hangers			
33	Counters			
34	Rivets*			
35	Pins			
36	Cols or bents			
37	Sole plates			
38	Masonry plates			
39	Shoes			
40	Rollers			
41	Shims			
42	Anchor bolts			
43	Wood blocking			
44	Cleanliness			
	STEEL BRACING	**A**	**B**	**R**
45	Top Lat			
46	Top Lat Pls			
47	Bot Lat			
48	Bot Lat Pls			
49	Sway Frames			
50	Portals			
51	Towers			
	FLOOR SYSTEM	**A**	**B**	**R**
52	Flr Bm Web			

ITEM NO.	FLOOR SYSTEM (CONT.)	A	B	R
53	Flr Bm Top Flg			
54	Flr Bm Bot Flg			
55	Flr Bm Conn			
56	Str web			
57	Str Top Flg			
58	Str Bot Flg			
59	Str Conn			
60	Steel Floor			
61	Conc Floor			
62	Wood Floor			
63	Waterproofing			
64	Ties			
65	Tie Sealing			
66	Timber or bar Spacer			
67	Guard rails			
68	Deck hardware			
69	Footwalks			
70	Handrails			
71	Drainage			
72	Cleanliness			
	TRESTLES	**A**	**B**	**R**
73	Bulkheads			
74	Piles			
75	Sills			
76	Posts			
77	Caps			
78	Corbels			
79	Stringers			
80	Cross Brace			
81	Long Brace			
82	Foundations			
83	Welds			

FOR IMMEDIATE ATTENTION: _____

REMARKS _____

NOTE: *DESCRIBE UNDER REMARKS LOCATION OF LOOSE RIVETS. USE BACK OF THIS FORM FOR SKETCHES OR NOTES.

A – GOOD CONDITION

B – NOT HAZARDOUS – NOTE ANY CHANGE NEXT INSPECTION.

R – PUT ON REPAIR PROGRAM

SIGNED _____ INSPECTOR

REVIEWED _____ SUPVR. B. & B.

NOTED _____ DIVN. ENGR.

CHICAGO, MILWAUKEE, ST PAUL AND PACIFIC RAILROAD

Steel Bridge Inspection Report

Bridge No : _____ Date: _____

Division: _____ Inspector(s): _____

_____

Location. _____ miles _____ mi. _____ ft. _____

Waterway. roadway. railroad: _____

Track	Type	No. of Spans	Length	Total	Height	Alignment

✓ - Satisfactory X - See Remarks 0 - Does Not Apply

TRACK:		f. Stringers Flanges, Web, Connections	
1. Line and Surface		g. Lateral Bracing	
2. Inner Guard Rail		9. Bearings	
3 Ties (Track or Bridge)		SUBSTRUCTURE:	
4. Ballast		10. Bridge Seats	
DECK:		11. Pedestals, Blocking	
5. Type - (Timber, Steel, Concrete)		12. Abutments - Timber, Steel, Concrete	
6. Walk and Handrail (No., So., Between Tracks, None)		13. Piers - Timber, Steel, Concrete	
		14. Scour, Rip Rap	
SPAN:		GENERAL:	
7. Main Beams or Girders		15. Paint	
a. Flanges, Webs, Stiffeners		16. Clearances	
b. Cross Frames, Diaphrams		17 Channel, Drift	
c. Floor Beams, Flanges, Web, Connections		18. Utilities, Attachments	
d. Stringers, Flanges, Web, Connections		19. Damage Rail, Highway, Boat	
e. Lateral Bracing		20. Observation under Traffic?	
8. Trusses			
a. Chords, End Posts			
b. Web Members Vertical, Diagonal			
c. Hangers			
d Pins, Connections, Splices			
e Floor Beams - Flanges, Web, Connections			

ITEM	REMARKS	PRIORITY*

*Priority Note: 1 Immediate need of repair
2 Schedule repairs within year
3 Can carry Keep under observation

(Use opposite side of sheet for sketch or other remarks as necessary.)

140.8-1

TIMBER BRIDGE INSPECTION REPORT

For ______ ____________ By **OSMOSE CO.**

Page ________ Territory ____________

Br. ____________ Type ____________ Panels ____________

Chord: Ply ________ Species ____________ Stgrs./Panel ________

Piles: Post Bt. ________ Species ________ Date Driven ________

Caps: Size ________ Species ________ Date Decked ________

DATE INSPECTED							
INSPECTED BY							
1. Alignment (Tang.) (Cv.)							
2. Approaches							
3. Rail (Wt. ________)							
4. Deck Hardware							
5. Ties							
6. Walk & Railing							
7. Curbs							
8. Inner Grd. Rl.							
9. Surface							
10. Caps							
11. Sub Caps							
12. Shims							
13. Stringers							
14. Piling							
15. Posts							
16. Sills							
17. Sash Braces							
18. Sway Braces							
19. Girts							
20. Brace Bolts							
21. Channel Location							
22. Drift							
23. Bank Condition							
24. Rip Rap							
25. Bulkhead							
26. Vegetation							
27.							
28.							

MARK FOR ITEMS

1. = Excellent Condition
2. = Above Average Condition
3. = Average Condition
4. = Below Average Condition
5. = Reject

— = Not Applying

X = Information in Reports

140.8-2

INSPECTION RECORD BRIDGE NO. ____________

ITEM NO.	DATE INSP.	REMARKS

PILE & STGR. BORING RECORD

140.8-2

Date _____ Bridge No. _____

LINE "A":
O = Original Pile
Ⓟ = Posted Pile
Ⓗ = Helper Pile
P = Pile to be Posted
☐ = Square Timber

LINE "C":
✓ = Pile or Post OK
R = Pile or Post Reject

LINE "D":
Condition of Stgrs. at Cap

LINE "B":
H-SW = Hammer–Sound Wood
B-SW = Bored–Sound Wood
ST = Shell Thickness–Inches
V = Void–Inches
H = Heart–Sound Wood–Inches
Ⓑ = Ht. of Boring above G/L* or below D/P** (Ft.)
D = Dia. of Boring (Inches)

Example: Ⓑ=2 4 ST 6 V D 13 or Ⓑ=6 6 ST 6 V 3 H D15

*G/L=Groundline W/L=Water Line
**D/P=Drift Pin Area

BT NO.	LINE	PILE NUMBER 1	2	3	4	5	6	7	8	TOTAL
	A									
	B									
	C									
	D									
	A									
	B									
	C									
	D									
	A									
	B									
	C									
	D									
	A									
	B									
	C									
	D									
	A									
	B									
	C									

140.8-2A

PILE & STGR. BORING RECORD

Date _____ Bridge No. _____

BT NO.	LINE	PILE NUMBER 1	2	3	4	5	6	7	8	TOTAL
	A									
	B									
	C									
	D									
	A									
	B									
	C									
	D									
	A									
	B									
	C									
	D									
	A									
	B									
	C									
	D									
	A									
	B									
	C									
	D									
	A									
	B									
	C									
	D									

Bridge No._____ **Location**_____

From_____ **To**_____

Inspector_____

Date_____ **Weather**_____

Span No.					
Class					
Length					
Year Fabricated					
Height (Base of Rail to Ground)					
1. Waterway					
(a) Scour, Filling, etc.					
(b) Revetment					
(c) Drift or Other Obstruction					
2. Condition at Bridge Ends					
3. Track					
(a) Alignment					
(b) Ties (Condition and Size)					
(c) Guard Timber					
(d) Hardware					
(e) Inside Guard Rail					
(f) Other Guard Rail					
4. Piers and Abutments					
(a) Stability					
(b) Bridge Seats					
(c) Pedestals, Grillages, etc.					
5. Bearing Plates, Shoes, etc.					
6. Anchor Bolts					
7. Steel Span					
(a) Alignment					
(b) Adjustment					
(c) Camber					
(d) Truss Members					
(e) Floor Beams					
(f) Stringers					
(g) Laterals					
(h) Bracing					
(i) Girders					
(j) Beams					
(k) Other Members					
(l) Fasteners (Rivets, Bolts, Pins)					
(m) Drawbridge Equipment					
8 Protective Coatings					
9 Fire Protection					
10 Attachments					

DIVISION ____________________

BRIDGE NUMBER ________ KIND OF STRUCTURE ________ LOCATION: MILE ________

NO. OF BENT	NUMBER OF PILE OR POST NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6	CAP.	SILL	HEIGHT BASE OF RAIL TO GROUND AT ST.

FROM ____________ TO ____________

ALIGNMENT ____________ BY ____________ 19 ____

NO. OF PANEL	NUMBER OF STRINGER OR PIECE NO. 1	NO. 2	NO. 3	NO. 4	NO. 5	NO. 6	NO. 7	NO. 8	NO. 9	NO. 10	LENGTH OF PANEL LEFT CHD.	RIGHT CHD.

_____ Division.

From _____ To _____

Report by _____ 19____

On Inspection of Bridges. No.					
Type of Bridge					
Year Built					
(a) Substructure					
(b) Superstructure					
Number of Spans					
Length of Spans					
Total Length of Bridge					
Size of Arch or Culvert					
Length of Arch or Culvert					
Height					
Number of Tracks					
Mile Post					

for fatigue cracks caused by repeated flexing of the floor beam web. Stringers should be checked for tension cracks at midspan.

Welds Should be Examined Carefully

Welded girders, a relatively new type of railroad structure, require a very close inspection. Some girders have developed cracks at weld splices in the bottom flange and at the bottom flange-web interface.

Trusses are checked for corrosion, loose or missing bolts in hangers, pin and pin-plate wear, loose I-bars, damaged end posts and counters, local buckling of compression members caused by overstressing and misalignment of the truss. Excessive deflection under load may indicate damage to the structure or

localized failure. The condition of the deck should be noted as well as the condition of the waterproofing and drains. Properly maintained drainage will prevent deterioration of the structure.

Upon completion of the inspection, a report noting any deficiencies is prepared and forwarded to the appropriate railroad officers.

Any changes in the physical characteristics of the structures are noted in the permanent bridge record files. Many railroads have placed this information into a bridge inventory stored in a computer. The program stores such information as the year the bridge was built, the type of construction and, in some cases, an operating rating of the structure. As bridges are replaced, the inventory is updated. The program has the ability to print out the total length of bridge, by type, for each line or operating division. Bridge inspection is a valuable tool that assists the bridge engineer and the B & B Supervisor in prioritizing maintenance work and bridge renewals. Inspections done regularly ensure the safety of rail traffic.

President Gould: Thank you Mr. Ladner for the practical information of this report.

I wish to thank this afternoon's speakers for an excellent program. Tomorrow's joint session starts at 9:00 in Regency A & B, the same room we were in this morning. I declare this session adjourned (gavel).

TUESDAY MORNING SESSION

September 16, 1980

The Second Joint Session of the Roadmasters and Bridge & Building Associations was called to order Tuesday morning, September 16, 1980, at 9:00 o'clock, Mr. D. J. Gale, President of the Roadmasters, presiding.

President Gale: Please come in to be seated.

Will the second Joint Session of this Conference please come to order?

I have one announcement. Our registration as of this morning was 729.

Ladies and gentlemen, members and guests, on behalf of the Roadmasters and Bridge and Building Associations I would like to welcome you to this second Joint Session of this Technical Conference.

At this time I would like to present to you the members of the Roadmasters Executive Committee who have worked so hard to get this Conference in order.

As I introduce you, will you please stand up and remain standing until all have been introduced?

On my extreme right, Mr. D. E. Staplin, Director, Manager, Rehabilitation Planning, ConRail, Philadelphia, Pa.

Mr. C. W. Moorman, Director, Assistant Division Engineer, Southern Railway, Andover, Virginia.

Mr. Ray Hernandez, Director, Track Production Manager, Southern Pacific, Houston, Texas.

Mr. Karl Sutherland, Second Vice-President, Superintendent Systems, Maintenance of Way, Canadian Pacific Rail, Toronto, Canada.

Mr. B. D. Sorrels, First Vice-President, District Engineer, Atchison, Topeka & Santa Fe Railroad, Amarillo, Texas.

Will you please applaud. (Applause)

The rest of these gentlemen will be introduced later.

I would now like to call on President Gould of the American Railway Bridge

& Building Association.

President Gould: Thank you, President Gale.

Echoing Mr. Gale's opening and on behalf of the American Railway Bridge & Building Association I wish to welcome you.

The gentlemen who I am going to introduce are Officers of the Bridge & Building Association who have unselfishly given their time to the success of this year's Conference. As I introduce each person, I ask that they stand and remain standing until all have been introduced. Please hold your applause until all have been introduced.

Mr. P. H. Saletnik, Director, Assistant Engineer, Buildings, C.&N.W., Chicago.

Mr. D. A. Bessey, Director, Assistant Chief Engineer, Structures, Milwaukee Road.

Mr. J. M. Williams, Director, Bridge & Building Supervisor, E. J. & E., Gary, Indiana.

Mr. C. M. Russell, Director, General Bridge & Building Supervisor, Southern, Greensboro, North Carolina.

Mr. W. J. Gunkle, Director, Senior Structural Inspector, ConRail, Philadelphia, Pennsylvania.

Mr. W. S. Stokely, Director, Roadway Engineer, I.C.G., Chicago.

Mr. O. C. Denz, Director, Supervisor of Building Maintenance, Milwaukee Road, Chicago.

Mr. R. C. McMaster, Junior Vice-President, Manager of Facilities & Structures, B. & L. E., Greenville, Pennsylvania.

Mr. J. W. Chambers, Senior Vice-President. He is Bridge Construction Engineer, MoPac, St. Louis, Missouri.

We will now applaud this fine group. (Applause)

President Gould: I will return the rostrum to President Gale.

President Gale: Thank you, Don.

I would now like to call on our Program Chairman, Mr. Ray Hernandez, Track Production Manager, Southern Pacific Railroad. Mr. Hernandez, will you come up and introduce our next speaker?

Mr. Hernandez: Good morning. Thank you, Mr. Gale.

Gentlemen, we are very fortunate today to have our neighbors from both the north and the south speak to us. As our next speaker, we are going to have Mr. George Van de Water, Chief Engineer of the Canadian National Railway System.

Mr. Van de Water was born in Lefroy, Ontario. He is married and the father of four children.

He enjoys golf, fishing and swimming.

He has a Bachelor of Science degree in Civil Engineering from Queens University.

Mr. Van de Water joined the Canadian National Railways, in the Engineering Department, in 1951 at Belleville, Ontario.

In 1958, he was promoted to Division Engineer at Hornepayne and then at Belleville, where in 1961 he was appointed Area Engineer.

In 1964 he was named Project Manager to supervise the Engineering of the Place Bonneventure complex in Montreal and subsequently conducted the railway relocation project in Ottawa.

In 1968 he became Area Operations Manager in Belleville and Manager of the Regional Region in 1970.

In 1973 he was named Regional Manager Express and Special Services for the Great Lakes Region.

He was appointed Chief Engineer, Systems, in 1976.

His topic today will be "Track Plant for the '80's." Ladies and gentlemen, please welcome Mr. George A. Van de Water, Chief Engineer, Canadian National. (Applause)

Track Plant for the '80's

By G. A. VAN DE WATER

Chief Engineer, Canadian National, Montreal, Quebec

Thank you, Mr. Hernandez, for that very kind introduction.

I would also like to thank the Executives and members of the Roadmasters Association and the Railway Bridge & Building Association for giving me the opportunity this morning to talk to you for a bit on what is going on on CN Rail in terms of providing the kind of track plant that is not only adequate for the traffic demands as of here and now, but adequate for the traffic that is projected for the future.

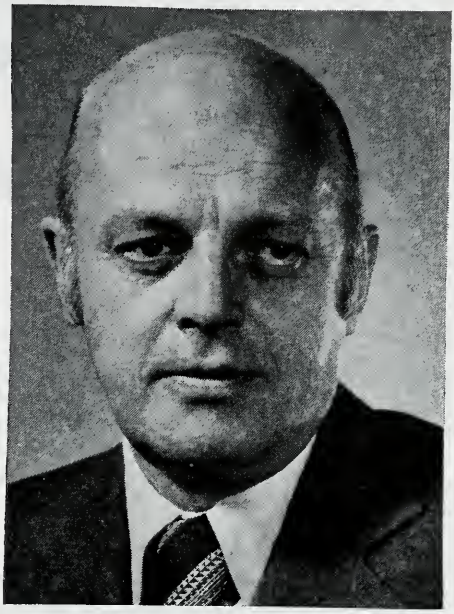
My talk this morning is divided into five main thrusts. I would like to talk about material life, what affects it, how we deploy it and, most importantly, what we do with it.

I am also going to talk about operating costs and the absolute necessity of engineering, doing the work efficiently and productively because only in that way do we contribute to the profitability that is absolutely essential if we are going to be able to put back into the plant the money to maintain it.

I am going to talk a bit about what we have been doing in the work measurement system for all the major work activities in engineering on CN Rail. And then, as it affects the requirements for training in terms of not only getting that work force properly deployed, but insuring some level of consistency in their ability to do the job.

Then we will look at some of the results we have been getting, not subjective results, but objective measures.

And then we will take a quick look into the future as to what we see coming up in terms of additional track capacity requirements to cope with the traffic in the 1980's.



George Van de Water

Material Life

In terms of material life, I think for an audience such as this we do not need to go into too much time as to what causes track deterioration. We will confine our impact to the two most expensive commodities in the track plant—rail, which costs us something like $200,000 a mile to replace—and ties, which run anywhere from $15 to $35, depending upon whether they are wood or concrete. That does not even include the cost of getting them in the track.

The life of the rail and the associated track components is in direct relationship, of course, to tonnage. A finite life exists per rail related to the amount of tonnage that is going to be carried over it. That tonnage relationship is further impacted by the axle loading, and, over the last ten years, we are not unique in that we have seen a rapid proliferation of the 100-ton or heavy axle load car and

Track Deterioration

we are convinced on CN that the equivalent tonnage carried in 100-ton cars wears out our rail about two or three times the rate of that same tonnage handled in 70-ton cars.

So that is a new part of the parameter.

Curvature has always been with us with little we can do about it. The fact is it does add an additional element for more rapid wear out of our track plant, when we introduce the lateral force over and above the vertical force exerted on tangents.

The fourth element is track condition. And track condition to the extent the geometry surface, the lines, the cross level and gauge are good, we can minimize the reverse impacts on those other three elements.

Conversely, to the extent they are poor, the rate of wearout increases on a non-linear basis and destructive wearout proliferates extensively.

Not much can be done about the tonnage as engineers or axle loading for it is here to stay, and increasing. Of course, the curvature, with few exceptions, is simply not economical to eliminate.

Track Conditions

The only variable we have to play with is track conditions and that is what I would like to talk a bit about this morning.

In terms of the elements about which we have been talking, I would like to take a moment to look at one of our route segments and I think it is reasonably representative picture of what is happening on many of our railroads in North America today.

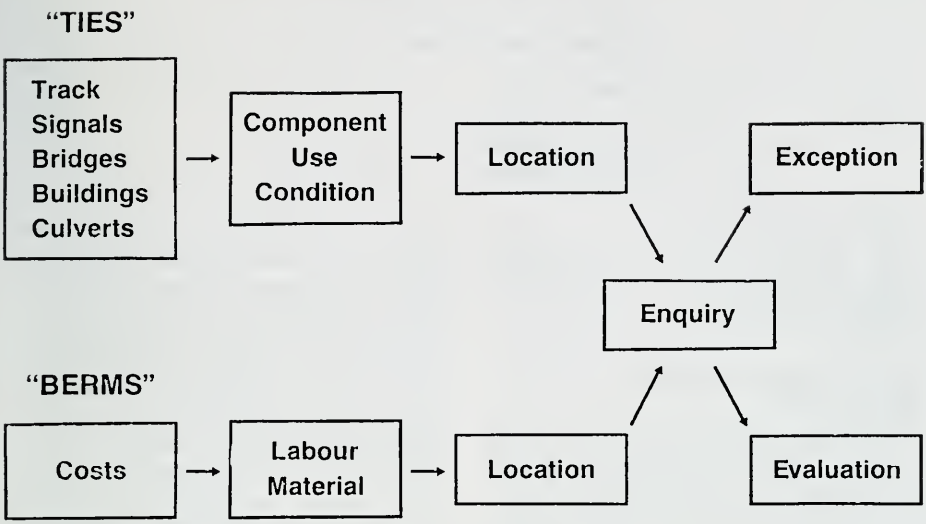
In 1968 to 1978, between Winnipeg and Vancouver, we have seen a 50% increase in the tonnage carried and we are projecting into the latter part of the 1980's a further 50% to 60% increase.

TRAFFIC DEMAND

Vancouver → Winnipeg

	1968	1978	1988
Gross Annual Tonnage	20-30 MGTM	30-42 MGTM	45-70 MGTM
Proportion—100 Ton Cars	0	15-25%	60%

Identification of Need



The fact is at this point, 1980, we are looking at a very significant movement towards that 1980 level to the point it will be reached over the next three or four years.

If that were the only problem, we would be looking at an increasing wear rate related to that tonnage of 50% to 60%. The proportion of 100-ton cars in that total traffic volume is increasing even more significantly. To the point that, instead of looking at rail wear at a rate of some 50% to 60% greater than in '78, we are looking at a rate, all other things being equal, of about two and one-half times. We simply cannot change rail at a rate of two and one-half times the level of 1978, because the whole equation would become self-defeating. We would be changing rail so rapidly you would never get a chance to move that tonnage. And, this is, of course, what we are doing in terms of coping with that need.

It starts in terms of getting a more rational and logical approach to the allocation of material, where it is going to do you the most good. We have a 24,000-mile plant on CN and we need more than manual tools if we are going to do a useful job in the allocation of our material resources. To help us, we

Track Deterioration RESPONSE

- Standard Ballast Section — 12" Rigid Specs
- Concrete Ties — Curves
- Chrome Columbium Rail Alloy — Curves
- Continuous Welded Rail

Track Deterioration RESPONSE

- Joint and Thermite Welding
- 136 # Rail Section
- Lubrication
- Rail Grinding
- **Maintenance**

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have developed over the past three years two separate but interconnected computer systems.

Two Computer Systems Being Used

The first system, known as TIES began with the track inventory and evaluation system and went on line in 1977. In the following two years the essential elements pertaining to signal plants, bridge plants, buildings and culverts have been added to that computerized inventory data base. In TIES system, now known as the total inventory and evaluation system, we have a reference by location for each of the components and the different elements of the trackplants. Its use has been put through and is conditioned in point of time.

In 1979, the BERM system, the Basic Engineering Reporting and Management system, also went live. We began reporting all labor costs, whether maintenance operating or capital by the same location reference contained in the TIES Inventory Data Base. What that permitted us to do is link up with the Use and Condition Reference Cost Data.

The material aspect for the BERM system is just in the process of implementation. In fact, this fall we will begin the requisitioning of all material requirements through some 90 input/output or cathode ray devices across our system in our Regional Office at Headquarters. It eliminates the whole process of paper rattling from level to level. It simply means you can order material anywhere on the system simply by punching out the request on the input/output device and all that is required is that that material request has already been referenced in the forecasting inventory introduced in the year preceding the year for which the material is required.

Next year we will add an inventory control aspect, which means that as the individual in the field orders his material, assuming he has gotten his authority for its prior inclusion in the forecast, the system will reference not only that authority, but it will also reference the appropriate location of the material in terms of the inventory situation.

In terms of assistance in allocation of material, the system provides for inquiry, wherein we can establish any set specified tolerance level and request from the system the portions of the plant where individually, or, collectively, the use, condition and cost element exceeds that specified level. That permits us to zero in, not on, a 24,000-mile plant, but those portions of the 24,000-mile plant that exceed those specified tolerances. You can set whatever tolerance you wish and what it does do is zero in on those portions requiring additional engineering evaluation and final selection as to the appropriate installation of material.

The beauty of these two systems is, unlike many, they have been developed by engineers and they are basically used for engineering. They serve many other purposes in CN Rail, of course, but the essential need and the essential purpose is for engineering use.

Start with Foundation And Work Up

Now, we hope we have the material

where it is required. That is not, of course, the end of the story. We have to maintain it. In terms of maintenance you do not start with the rail and work down. You start with the foundation and work up, starting with the drainage, subgrade, up through the ballast, ties, and then, and only then, you think about rail.

Over the 1976 to 1981 period we have installed on an average on an annual basis about twice the ties and twice the quantity of ballast, that we had installed in the previous period between 1970-75. We are also installing in that period, 1976 to 1981, on an average about 22% less rail than we used in the preceding 5-year period, and that is in the face of about a 25% overall increase in gross tonnage and significant increases in the incidence of the 100-ton or heavier axle load car.

The economics are very attractive. We are spending more, of course, on ties and ballast, but we figured out not too long ago if the rail replacement rate had been allowed to increase from the 1970-75 base in relation to tonnage and heavier axle loading, we would have been spending another $60 million in 1981 for additional rail relay over and above what we actually propose to do. This, of course, is a far greater offset than the additional cost for the ties and the ballast.

Use of Concrete Ties

In 1977 we started putting concrete ties into our track on a production basis. Our criteria that have been developed over extensive years of testing and evaluation calls for the installation of concrete ties in curve track, and only in curve track, on our heaviest lines, and where we have our heaviest incidence of 100-ton cars. At this point that rather well ties it down to the route segments between Montreal and Winnipeg and between Edmonton and Vancouver.

The concrete tie track is more expensive than wood tie track. Some $35,000 per mile in 1979 dollars, compared with around $26,000 for conventional wood track. But we found the advantages and benefits far outweigh that initial cost for the concrete tie track and we are getting our pay back in a variety of ways. We are getting longer rail and longer tie life in this kind of an operating environment. We find we can eliminate one complete lift and surface cycle in a 5-year period with the concrete tie track compared with conventional wood.

We built right into our work measurement system a 30% reduction in regular maintenance with the concrete tie track. An element of reduced fuel consumption is in this, too. The Canadian Institute for Guided Ground Transport developed a formula a few years ago and the indications they came up with were 2.3% reduction in fuel on comparable track sections. We think it is conservative but we are using it because at least it is solid.

Putting all these things together we are getting the return on the additional investment for concrete tie track used on this criteria of 43%, but it is still an element yet to be identified, such as the reduction in demand for track capacity with concrete tie track and the reduced maintenance and such things as wear and tear on rolling stock.

Chrome Columbium

We adopted the chrome columbium as our standard alloy for use on curves and in heavy tonnage territory. We were talking about chrome columbium which we adopted as our standard a year and one-half ago for us in curve track on heavy tonnage territories and we are looking at a projected additional rail life of some three times that obtained with the high-fi alloys, our previous standard for curves, and some four times the equivalent life with carbon rail.

Continuous Welded Rail

Continuous welded rail is standard for all rail replacement programs, whether they are PW or new or whether they are on tangent or curve on CN. At the present time we have about 6,000 miles of CWR on our main line routes, and that is increasing at the rate of about 400 to 450 miles a year.

We are getting some 40% additional rail life with the continuous welded rail as compared with the conventional joined.

Joint and Thermite Welding

We are doing more joint and thermite welding than ever before. A thermite weld, of course, is a field weld to tie together the 1482-foot strings of track. We have been experimenting this year with a new in-track butt-weld equipment which has the prospect of not only doing a higher quality weld than the thermite process, but more economically, and we are hopeful that will be proved out this year.

Joint welding is done where the rail programs are done some years in the future and is designed to improve the track geometry at the joint and eliminate the surface irregularities and thereby get an extended rail life.

Rail Sections

We have 136-pound rail sections compared with 132 some years ago. It is only a 4-pound difference, which does not seem to be very significant. The fact is the entire four pounds are in the head of the rail and we are getting another 40% additional rail life on that account.

Lubrication

Lubrication is something on which we have been doing a better job in the past few years, not so much by having more lubricators. We had enough. Not so much by changing the type of lubricators, but by seeing they are properly maintained so that they function well.

We have changed the whole maintenance approach in that in the past it was left with the local track force to handle, it was a dirty job, it was a technical job and, too often it was, the last job and never was done. We now have dedicated maintenance who do nothing but work on lubricators. They spend all their time on a scheduled basis in doing the work and, of course, they bring to it the appropriate technical confidence to get it done well.

Rail Grinding

One disadvantage of the concrete tie is the more rapid propagation of corrugation and its occurrence at a much earlier stage. In this connection we are doing much more grinding than we have ever done before, particularly, where we have a heavy incidence of heavy axle loads. On some of our routes we are grinding out of face as often as four times a year. That additional cost is taken into account in the economics we were talking about before. It does not have any overall impact on the desirability of the concrete ties. It is just one negative element in a whole host of positive ones.

Maintenance

Once we have all that good material in the track and we are doing all those useful things, we also have to maintain it. Four years ago when we took on the challenge of managing our rail to the point where we were going to stabilize the level in spite of the increasing traffic. In fact, to lay it at a reduced level from what had been occurring during the previous five years, we established a $5 million special rail maintenance fund. It is available each year for selected work on our main line routes, with special rail maintenance. This is inflated on an annual basis to insure the equivalent physical labor which covers a whole host of extra-curricular activities related to grinding, welding, surfacing, etc.

With the joint rapidly going the way of the dodo, we found the turnout and the crossing are probably the two weakest links remaining in the track plant. And, again, much like the lubricators, too often they were left for the local track foremen to do without adequate equipment and possibly not the appropriate dedication.

We now have special gangs set up operating separately from the line production gangs equipped to do the skeletonizing and lifting through the turnouts

and at crossings use Gopher undercutters and switch tampers. It is not only doing a better quality job but it is doing it at the appropriate time renewal.

We are deploying a variety of pneumatics on our lines and we are getting more production from them. We are hopeful that next year the compaction tamper will be available to give us another impetus in the ability to do additional surfacing and lifting at a more economical cost.

Over and above everything else, we have the training, which we will be dealing with a little more detail later, and the deployment of the work force related to the work measurement system.

All these things put together are giving us the situation where we are, in fact, installing less rail today than we were some years ago and we expect and project a relatively stable level of rail replacement within two or three years.

We are looking at a doubling of rail life on tangents, more than tripling it on curves, significant increases on tie life curves, and what this is permitting us to do is establish a stabilized level of expenditures and cope with the increased work load through productivity.

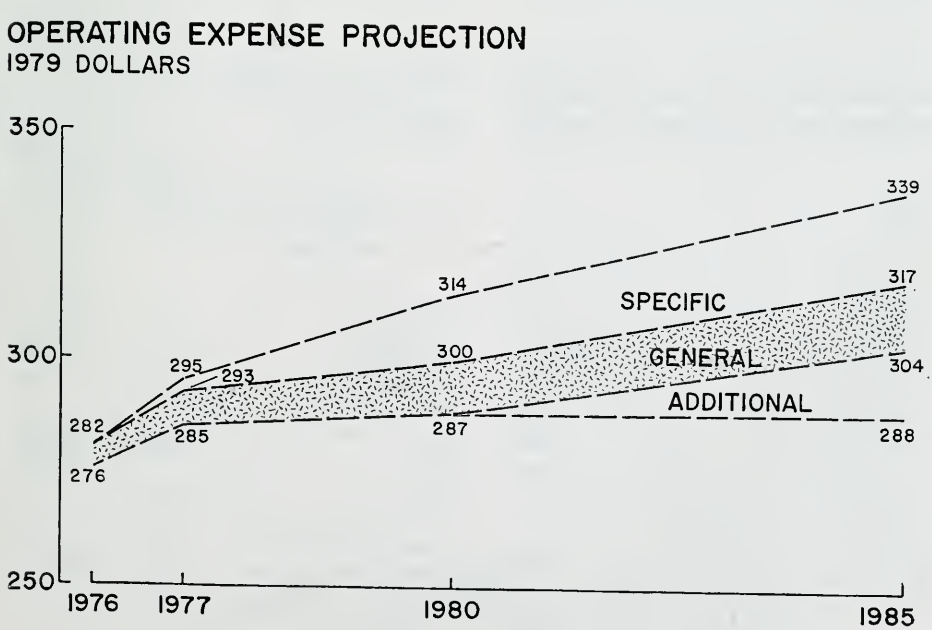
Operating Costs

That leads us into the next element, which is basically related to productivity.

This particular chart shows our operating expense situation, from 1976 through 1980 and projected through to 1985.

The top line is what would have happened through 1980 and will happen through 1985 if we had no such thing as productivity, the ability to do equivalent work more effectively and more efficiently. The bottom line is what has happened through to 1980 and through to 1985 what we project is going to happen. It is all expressed in equivalent 1979 dollars, so we are comparing apples with apples.

The top band, called specifics, is related to identified projects involving an allocation of capital to do a specific piece of work or to buy a specific piece of machinery to do a job a little better, and that contributes to a most dedicated in-



vestment and specific projects.

In general it is what you get from a better deployed, more competent work force. And you do not identify it by specific projects. It just happens each year that things get done a little better, a little more efficiently.

The third band, called Additional, is what we are going to have to find between 1980 and 1985 to keep that operating expense stable.

Communications Systems And Training

To take a look at some of the specific things related to that previous graph, it starts with Communications. We started some while back with the installation of an exclusive engineering radio network system on our main line route from Coast to Coast. And this system is completely separate from the transportation radio system. Of course, it does interface with it. But it is for our exclusive use and is just another tool in the requirement to better manage the kind of work force we have distributed over a system the size of ours.

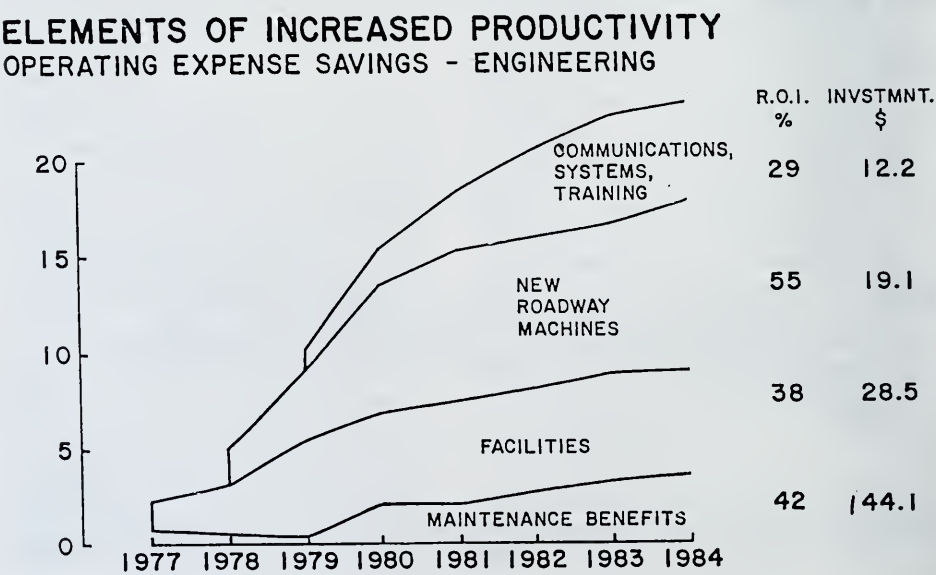
We have also invested in training facilities. We will be talking a little more in detail about that later this morning.

In that general area we have an investment of about $12 million over the past few years and a return of around 29% projected.

Roadway Machines

We have some pretty exotic numbers in the new roadway machine category. It starts off with C-11, installation of concrete ties. When we were faced in 1977 with the supply of some 300,000 to 350,000 concrete ties a year in the area that we had established on curves, we came to the conclusion a year previously that the conventional gantry system of tie replacement was not what we needed. With the gantry system and the requirement for rapid cut-in and cut-outs, working under restricted work blocks, we could not see ourselves installing more than 1,200 ties a day at an average cost of about $15 a tie. Neither one is really acceptable.

That started the research for a machine utilizing a radically different concept, which is, of course, the continuing replacement, tie-in, tie-out, and that led to the C-11.



At the time it was on the drawing board we were looking at the prospect of eventually installing 2,400 ties in a 10-hour work block, and that would have been more than adequate to handle our projected annual production of 300,000 to 350,000 a year. We were looking at a cost of around $5.00 a tie in place.

This past summer, east of Winnipeg, the C-11 averaged 3,454 ties in a 7½- to 8-hour work block and the cost of installing those ties was a shade over $3.00 a tie. That, gentlemen, is productivity. And the relativity of that kind of cost in terms of what we were looking at two years ago means a saving of our operating dollars to the extent of two to two and one-half million dollars a year.

The RCO is the grandchild, or conversely the C-11 is the grand-daddy for the RCO. The C-11 came complete with an excellent rail exchange system, because we had to get the rail out of the way to take out the wood tie and put in the concrete tie. Some genius figured utilizing that rail exchange system and substituting the preparation of the wood tie for the wood tie-concrete tie exchange would give us a production machine that could completely change rail relaying. That is actually what is happening.

We took delivery of our first RCO in the fall of '78 and took the second one in the summer of '79. We had a very frustrating and very trying 1979 with, first, one and then the second machine—modifying, adapting, changing. Then toward the latter part of '79 we got the breakthrough we had been looking for all year.

Some fairly extensive modifications were carried out in the 1979-1980 winter and two of them were in production this year. They are working extremely well and are getting close to the projected two-track-mile-a-day prospect for which we had hoped. At the present time, they are averaging 1.5 to 1.6 miles a day. They are working an 8-hour work block, not the 10 we had originally envisaged.

I do not think a question is raised that the C-11 and RCO's are going to improve each year. Our original expectation of two-track-miles is going to increase.

In terms of doing rail relay with 2 RCO's compared with the five conventional rail gangs we had in previous years, we are looking at ultimate savings of $2 million to $3 million a year. Again, right off the bottom and a contribution to the profits.

Other things are in that arsenal of roadway machines. I will not go into detail but they are all helping—jointed rail pickup, the Gophers, mechanized tie unloaders, geomatics, eventually the high mileage—all these things are giving us the opportunity to do work more effectively, more productively and with a combination of more work at less cost, you just cannot beat it.

Facilities

In the facility area, we have been active. We developed in work equipment a few years ago preventive maintenance standards for work equipment. The objective here was to maintain the equipment before it went out into the field as opposed to repairing it in the field tying up the whole gang. But we needed new work equipment facilities to apply those standards and we constructed five across the system, one in each region. We are applying the standards and are getting additional productivity in the shop, but the most important productivity we are getting there is a significant reduction in down time with the production gang, with equipment working more reliably.

We completed the modernization of our Belleview rail yard in 1978. We started a similar modernization program at Transcona, our other system rail yard in '79, and it will be completed next year. Of course, the maintenance benefits we have already talked about, the additional capital for such things as concrete ties, 136-pound rail, chrome columbium alloy, and the kind of feedback we are getting, all these things are helping us to get the money to do the work because for every dollar we save in engineering, it is a direct add-on to the net profitability of the Company.

Redeployment and Training

In terms of redeployment, we are using work measurements in all our major work activities, including track, bridge and structures, signals, work equipment, and welding. What we are trying to do with the work measurement system is to deploy the maintenance work force or resource more equitably in relation to the location of the work load.

Now, time does not permit going through all the systems. We have touched on the track and the bridge and structures work measurement to give you an idea of how it works and let it go at that.

Track Maintenance

In terms of track maintenance, we had to make two basic assumptions right at the start. The first assumption was that our total work force was about right for our total work load. We did some spot comparisons with other roads around North America and that assumption seemed reasonable and nothing indicated it was excessively out of 'whack' one way or the other.

The other assumption was that we would be able to handle the additional workload each year, additional plants, additional tonnage, with that same work force. But we would have to deploy it in relation to that changing workload if we were going to have a chance to accomplish it.

Once those two assumptions were behind, was the matter of developing the units themselves to measure the work load.

Of course, if every mile of track was like every other mile of track, it would be a simple problem. You would take your total miles, divided it by your total maintenance employees, after making allowance for all those things that maintenance employees do unconnected with maintenance, and you would have your work units per equivalent maintenance man year.

As we all know, no one mile of track is exactly like any other mile of track. That is when you start getting into the adjustments, the factors that add or subtract workloads. You start with such things as turnouts and crossings in that mile of track, what type of tonnage you have on that piece of track, the speed at which the traffic moves, the curvature, the amount of it and the type of it, whether you have heavy axle loads and how much, what your ballast section is like, the conditions, and the type of ballast you have.

The condition of the track certainly contributes or reduces the requirement for maintenance, the weight and condition of the rail, the track modulus, the gradient and the concrete ties.

No way on a 24,000-mile system can you manually interface all these elements, all of which affect the equivalent workload on a piece of track. You simply could not cope with it manually. That goes back to our computerized data base where we are able to plug in all these elements as they apply to a specific piece of track and get a measure of the work load in relation to all the other miles of track and their equivalent workload. Then you take that total work force and you distribute them according to the workload, as it has been measured and adjusted and changed by these elements. Then you look at what you actually have to deploy and it does not take long to find out where you have a surplus and where you are short.

We have been redeploying maintenance manpower between the regions since 1979. We just finished last week the final decisions on the redeployments for 1981. This will be the third year.

These are how the relativities looked a year ago, before the 1980 changes were made. You see some regional averages there. If the work force and workload were appropriately deployed, all those numbers would be the same, obviously. We see one region at 5.8 work units per maintenance man year, and here is the other extreme, 7.5. It simply means the 5.8 is over-staffed and the 7.5 is under-staffed. All on a relativity basis.

The adjustments done for 1980 have

Main Lines – 1979
Work Units/Maintenance Man Year

Regional Averages

5.8 7.4 7.5 6.9 7.2

System Average by Track Classification

Tonnage	25 MGTM+	15-25 MGTM	5-15 MGTM	1-5 MGTM	<1 MGTM
Mileage	2525	3983	4033	7229	4631
Work Units/ Mtce. Man Years	7.4	6.6	6.7	7.4	7.0

corrected that. We got a better relativity going into 1981.

The other element, you must remember, is that your work load is not static—it changes annually. But it does not increase proportionately across the whole system. Each year it has to be done, and related to that changed work load and handled with the same total work force level, we deploy each year.

Also shown is the distribution by tonnage territory and that is getting closer, too, but, again in an ideal situation, they will all be equivalent and maybe someday they will. The thing is, we are always chasing that elusive thing called workload. It is not static, and it changes every year.

Bridges and Structures Maintenance

We turn to bridges and structures. The approach is a little bit different in that their workload is significantly different. But it does start with the same availability of a computerized data base for all bridges and structures.

If you start with a so-called system average, which in itself is pretty meaningless, you simply translate your bridges into lineal feet, take the maintenance manpower, adjusted by the maintenance manpower does not do maintenance, and you can get for bridges a system average expressed in the amount of lineal footage of bridges one maintenance man year can perform per year.

However, like track, no two bridges are the same and you have to start to make adjustments, in relation to such things as the traffic on it, the tonnage carried, whether it is heavy axle load or otherwise, the condition of the structure, environment, geometry of the structure, and its distribution.

Then you can adjust those system averages and end up with something like this. Those timber trestles, for example, show, after consideration of all those individual things that affect the required maintenance needed in any one year on any one structure, that on a region like the Great Lakes one man year is able to do only about half the workload of an equivalent man year on the Atlantic region. This does not indicate that they work twice as hard on the Atlantic region—far from it—but it does mean that because of the complexity of the traffic, the conditions, the geometry, the environment, and all the other elements, they need to do almost twice as much maintenance at this particular point on timber trestles on the Great Lakes in relation to an equivalent man year.

All you have to do from here, of course, is take a look at how that relates to the manpower that should be deployed, assuming again that the equivalent total number of employees is adequate, but deployment is not, compared with what you actually have and make your adjustments.

Must Have Work Force Trained

We started moving bridge and structures manpower between the regions in relation to the workloads for 1980 and we are in the process of doing it again for 1981, which will be the second go-round.

Once you have the work force where the workload is, in sort of an equitable relationship, you have to make sure that the work force is given some consistent level of competence or the whole thing goes down the drain. Of course, that is where the training comes in.

Three years ago, we had no training for track employees. We really had no effective training program for welders or bridge structures. Fortunately, the singles and the work equivalent were good. After a considerable amount of development work and negotiations with the brotherhoods, a new track training program got off the ground in 1978. It contained several very essential elements in terms of making the whole system work. For example, no longer does seniority apply for promotion. We have an agreement that the employee electing for promotion has to qualify through training before seniority can apply. We also got an agreement with the brotherhood that new employees must qualify, again, through training, in the track maintainer classification if they are going to continue their employment.

We also established and set pay rates for incumbents. They are also required to take the training program to qualify for the incentive. At the present time, the program is training all three classifications, incumbents at the level of the position they enjoy, employees electing promotion at the level they wish to promote to, and new employees, of course, as they come into the work force.

In about a year the incumbent portion will be pretty well finished and we will concentrate exclusively on new employees and, of course, employees electing promotion.

Our work measurement system for welding indicated a couple of years ago that we not only had an inadequate number of welders employed in relation to workload, but that the welders we actually had were not properly qualified nor trained. With the track program out of the way, we started the redevelopment of a program for welders. It went live in 1979 and reflects not only the new program, but a much higher level of training required to build that work group up to a relativity with the measured workload.

Bridges and structures showed some training done from 1977 to 1979, but it was rather perfunctory. In 1980 no training was done, while we concentrated all resources on the development of a new comprehensive program that will be patterned on the track program and will be starting early in 1981, the spring of 1981.

Since 1978 we have spent $4 million on new facilities for training, class rooms, bedrooms and the rest. In 1980 we have spent about $6½ million on the training of engineering employees. We will be going up to $7½ million next year in relation to the bridge and structures group.

I personally feel that of all the expenditures we are making, this is probably the single most important one—training.

Results

Now we have told you all the good things we are doing in relation to material life, in relation to productivity, in relation to work measurement and training—I think it is time to take a look at some of the results we are getting.

Surface Roughness

One objective measure of the quality of the plan, of course, is the surface

roughness. The surface roughness is measured by the track geometry car. This covers the route segment from Capreol to Vancouver, all of Western Canada, and, of course, the section from Winnipeg to Thunder Bay.

In all these routes we have seen a significant improvement in the surface roughness index from 1976 to 1979. This is where, by far, the greatest proportion of the growing traffic has been coming and where we have, by far, the greatest incidence of heavy axle loading and the percentage of these root segments is better than the standard. The standard is not a safety standard. It is a quality standard, which is track, and this is also improving.

We see a similar relativity in Eastern Canada, from Capreol to Halifax, down to Toronto. The surface index is better by far and the percent better in the quality standard.

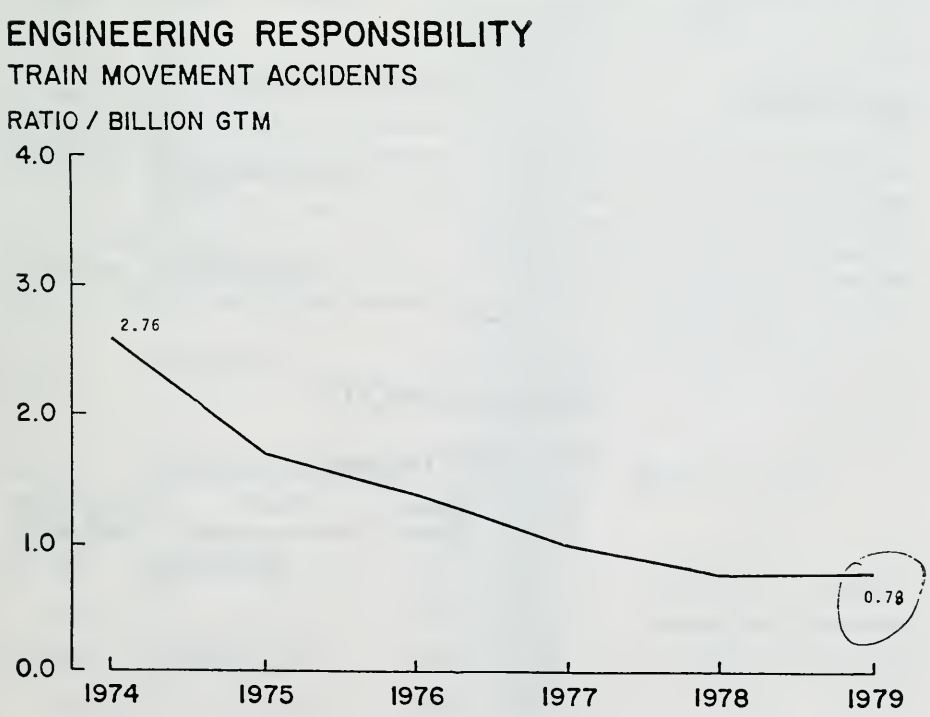
That is one measure. Another one, of course, is accidents.

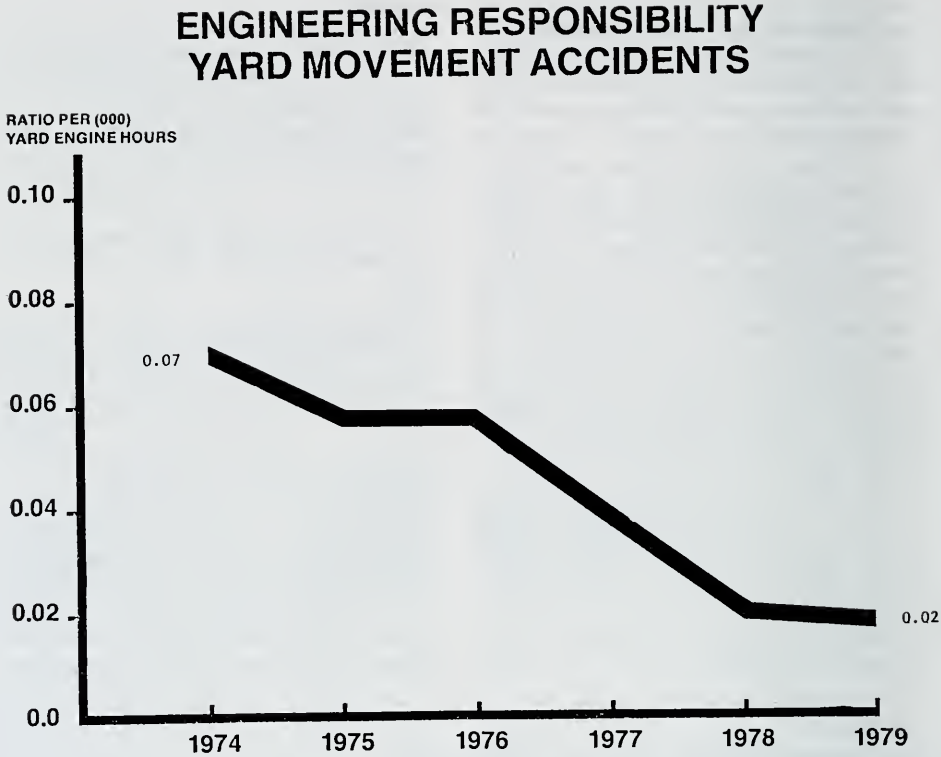
Accidents

Here we have a chart showing the ratio of train movement accidents related to engineering responsibility or track defects, if you will, what has happened from 1974 to 1979. A 75% improvement has been accomplished from 2.76 down to .78. In the first eight months of 1980 the ratio stands at .5, a further 35% improvement, 1980 over 1979.

Yard movement, a similar trend, a significant improvement—and it has carried on again over the first eight months of 1980. We have a ratio of .016 expressed at the accidents per thousand yard engine hours, and that is a 20% improvement in 1980 over 1979.

So, both of these things, the surface roughness, the train accident performance related to engineering costs do indicate that we are getting a better plant, we are getting a stronger plant, we are getting a plant more appropriate for the kind of traffic levels we are experiencing.





Track Capacity

That is only half the battle. You can have the very best track in terms of its existing geometry, but you do reach a point where the traffic is just too much to handle and you start looking into expansion.

That is what we look at briefly here. This is what has been going on, basically completed in 1980 although it does show it going over into 1982, and the physical work, as I say, is done. The carry-over is primary signal completion.

What we have done here is constructed, or extended, some 200 sidings between Toronto and Vancouver to pro-

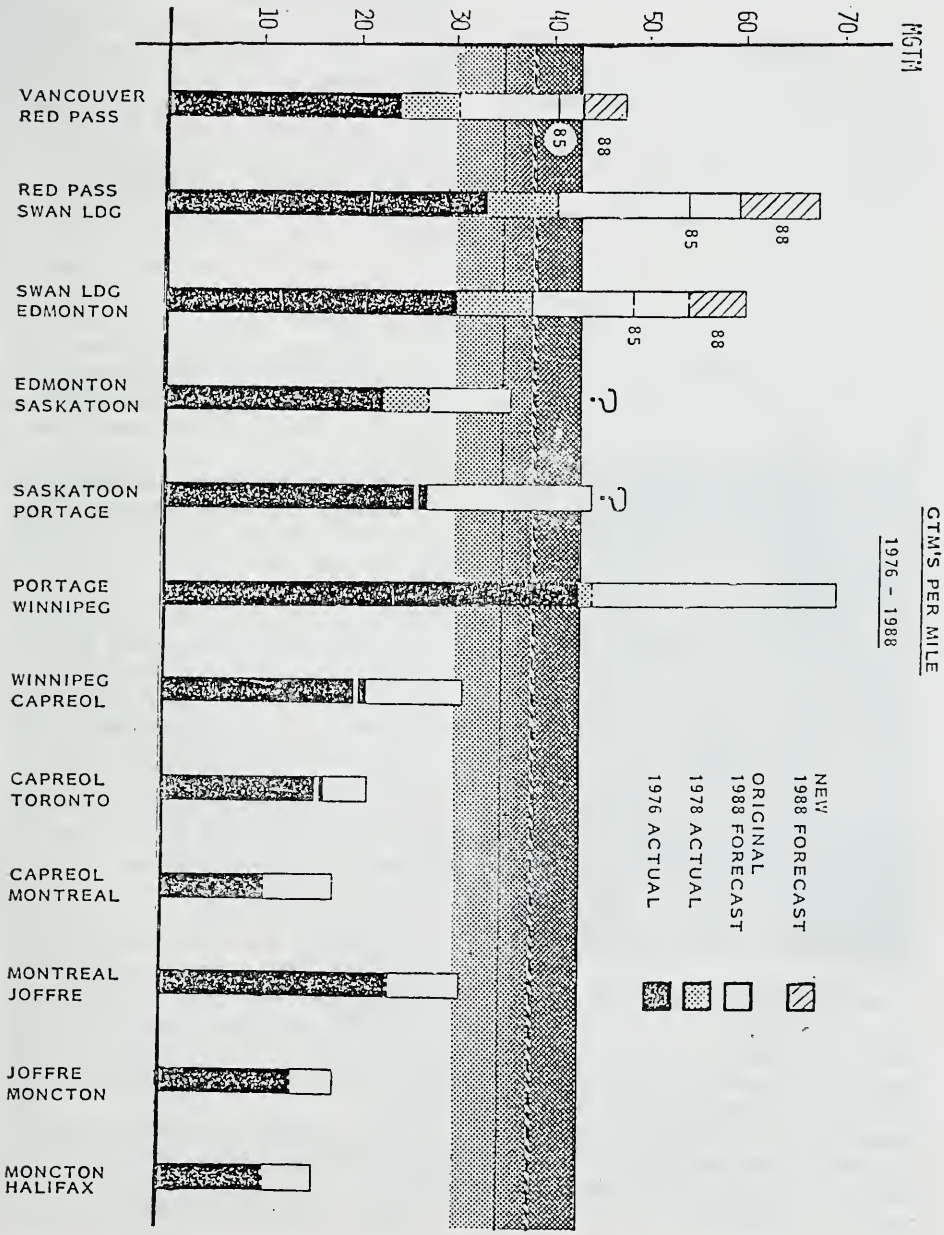
TRACK CAPACITY

1976-1982 Program

	Sidings	Double Track	Yard Improvements	Expenditures ($000,000)
Edmonton/Vancouver	24	23	4	68
Winnipeg/Edmonton	69	35	7	106
Toronto/Winnipeg	107	10	5	108
	200	68	16	282

vide 125-car capacity. That 125-car capacity per each train has permitted us to absorb the traffic increases from 1976 to 1980 without dramatically having to increase the number of trains we have operated. We have also done significant work in yards on the line and done some minor double tracking along the way. We spent about a quarter of a billion dollars and it is just about already used up.

Capacity requirement beyond 1980



cannot be met by any further extension of trains. It has to be met by providing additional capacity on lines.

This gives you an indication of where we were. This is a graph that was done about a year ago. It shows the 1976 traffic level by route segment. It shows the 1978 and the projected 1988 at that point.

As I mentioned before, on portions of the route, particularly between Edmonton and Vancouver, that 1988 projection looks as though it is going to be achieved two or three years earlier than originally forecast.

That solid white band down the middle is the range of tonnage that you normally start thinking very seriously about double tracking. It can be down as low as 30 and it can be up to as high as 45 MGTM. We are already over that band as of 1980 between Edmonton and Swan Landing, and Swan Landing and Red Pass, a distance of about 230 miles. From Portage to Winnipeg is already double-tracked. That was done a few years ago. But it does mean that events have sort of passed us. We were planning our expansion in relation to the projections and the projections now appear to be conservative.

This is the way the program is constituted at the present time. It calls for double tracking between Swan Landing and Red Pass by 1985, and the original plan in relation to the original traffic forecast for double-tracking between Edmonton and Swan Landing by 1988. That has to be tightened up and brought back to 1985 if we are going to Vancouver on that route.

Red Pass Junction to Vancouver is a distance of 370 miles—we will probably be able to get away with extensive double-tracking with some single track sections remaining. It will all depend upon the ability to manage the train pattern and the work programs in relation to what comes out. But again, the preponderance of expenditure was in the mid-1980's, extending out to the latter part, and it looks as if that is going to have to be tightened.

Ft. Dodge-Edmonton similarly. That was in the latter part of the '80's, when the traffic again is making our forecast look conservative. Winnipeg-Capreol is way down toward the end of the 1980's, and with the demands occurring on the other stretches of the route, it looks as if we will not be able to move that one up very much at all.

Overall, we are looking to spend about a billion dollars, an equivalent of 1979 dollars, over that 8-year period. The only question now is, how much we can increase that rate of expenditure to relate that plant more appropriately to the traffic being handled.

So, there it is, gentlemen. It is an insight into what we are doing on CN rail, not only to improve the plant as she is, because that, of course, is the first essential. If you do not have that, the rest of it is irrelevant. We have shown what we are doing in terms of expanding that existing plant to cope with the traffic in the 1980's. Thank you very much. (Applause)

Mr. Hernandez: Thank you, Mr. Van de Water. We certainly appreciate you being here and we enjoyed your report.

Ladies and gentlemen, our next speaker is from the National Railways of Mexico, the southern part of our country, you might say, our southern neighbors. It is very appropriate because today is the 117th Anniversary of Mexican independence, the 16th of September.

To give this report we have the retired and recalled Civil Engineer of the National Railways of Mexico, Mr. MacNiece.

Mr. MacNiece holds a Civil Engineering degree from the National University of Mexico. He has attended Northwestern University at Evanston, Illinois, George Washington University in Washington, D.C., and numerous seminars, both in Europe and the United States.

He is a member of numerous associations throughout Europe and the United States.

His career began in 1944 as a Junior

Engineer of the National Railways of Mexico. He progressed up through the ranks to where in 1968 he served as Assistant Manager of Track Structures, Tele-Communications and Signals for the National Railways of Mexico.

In 1971 he retired. In 1973 he was appointed Chief Engineer of the National Railways of Mexico.

Mr. MacNiece will be assisted by his Assistant, Mr. Vargas.

Ladies and gentlemen, I would like for you to welcome the Chief Engineer of the Mexican Railroads, G. Rodriguez MacNiece. (Applause)

Modern Track in the National Railways of Mexico

By G. R. MacNIECE

Chief Engineer, National Railways of Mexico, Mexico City

Thank you for the presentation, Mr. Hernandez. Ladies and gentlemen. I appreciate very much the opportunity to speak to you at this convention.

National Railways of Mexico purchased in 1969 two sets of machines for integral track renewal named SECMAFER which is a sophisticated method of relaying track. The machines require a number of flat cars to transport the machines, the concrete ties to be installed, the gantries that are going to dismantle the old track panels, and to allow using the long welded rail laid besides the track. These rails are laid over the ballast shoulder, previously, and by use of timber blocks which allows them to be in good gauge and at the necessary level.

The positioner blades utilize the existing ballast and by the using of the same positioner changing the tool, we install the CWR which is going to support the traffic of the SECMAFER machines.

The rail joints overlapping are previously eliminated to facilitate the transport of the old panels to a dismantling yard, in which the material is classified.

G. Rodriguez MacNiece

The irregularities of the ballast produced by the voids left by the old ties, are eliminated by means of the ballast grader and the old ballast is redistributed, equalized and compacted to permit the accommodation of the new con-

crete ties over a leveled and compacted surface. The beam and gantries that transport the concrete ties will lay them in two steps, first unloading the odd ones, and, second, the pairs, in such a way that at the end of the second stop they will be spaced 61 cm. center to center (2 ft.). This ingenious deposit permits a wonderful mobility of the concrete tie, if we consider that each one weighs 240 Kg. They remain perfectly aligned, leveled and squared ready to receive the rubber pad, which may be, or, may not be united to the concrete tie in order to immediately lay behind, with the rail laying machine, the two new CWR's and afterwards we locate rail fasteners (bolt, clip, cushion) which compose the double elastic fastener. By means of a mechanical torque wrench we tighten the nut bolt to 20 ton-m, getting, this way the rail fixation with the final position and gauge. Over these tracks we will distribute the new ballast in sufficient amount to allow a multi-tamping-leveling machine to produce the necessary lift to relevel and tamp the track. Immediately behind a track lining machine eliminates the cross line defects of the track in such a way that we finally get our track leveled-tamped and aligned. No doubt the lining machine may disturb the track level, consequently, it is recommended to have another tamping machine behind the liner. The ballast equalizer will reshape the ballast shoulder and after brooming the track we finally return the track in perfect condition to train traffic without any low speed restrictions.

Must Use Standard Equipment

As the track renewal programs have been very ambitious, we needed to find the way to take advantage of utilizing standard maintenance of way equipment to assemble a group of machines capable to produce the same volume of work approximately, but in a less sophisticated and accurate way, and, in that form, to maintain the standards inside the permissible tolerances to allow the track renewal in a similar rhythm.

We must make clear that the SECMAFER group produces 1100 m. of track renewed in 6 hours of effective work subject to the traffic density and to the dispatcher's convenience.

We find that this second procedure is very recommendable, because most of the railroad companies have this type of equipment with two or three other optionals as we will see further ahead, which have permitted productions in a same lapse of about one kilometer, but, unfortunately, the normal time allowed for this purpose, has been from 4 to 5 hours, which only permits productions from 600 to 800 m., due to the time involved in getting into and clearing out the track.

Once that we have partially removed away the ballast from the track, and applied the same track relaying procedures, well known by all, using nut unfasteners and spike pullers, we liberate the rail at the desired speed, putting in the amount of necessary machines to reach the production previously planned of rail substituted by the modern track that we are showing. By means of the use of the manual tools, it is possible to dismantle all the materials, and, considering that the concrete tie has been previously unloaded and distributed along the side of the track with a track crane, using several tie inserters these are spaced, lined and inserted underneath the rails. This gives a fabulous aid because of the short hand work required taking into account the acceptable accuracy of the production obtained this way. The distribution of the accessories is made by hand, and with special manual tools we eliminate the concrete burrs from the tie shims, thus assuring no further problem in the application of the fasteners. The track bolts are applied by hand and tightened with a mechanical torque wrench which reaches 20 ton-m. It is only necessary to watch out that the clip does not suffer overtightening which may result in a plastic deformation of it, scrapping it out immediately and simultaneously

deforming the rubber pad which supports the rail, the cushion and the insulating washer. Normally we use a human force of 50 people for this kind of work.

Ballast Important

Now we proceed to unload the ballast in order to tamp-level-line the modern track. To do so the material quality is controlled from the same moment it is produced in the bank, during the loading over hoppers and at the unloading, which permits the utilization of work trains with 20-30 units that are unloaded at an approximate speed of 5 minutes per unit, a very reasonable rhythm between the journey allowed by the train traffic.

Once the ballast has been distributed we proceed to lift, level and tamp the track using a multi-tamping-leveling machine with delta system. Immediately behind, trying to keep the machines as close as possible, we have a track lining machine followed by a simple tamper that tightens all that the liner might loosen and not affecting the new modern track. Immediately behind the ballast equalizer, by means of the appropriate movement of the ballast, reshapes the track bed shoulder and recovers the material existing on the embankment shoulder, filling the spots that need it. This equalizes all the profile in order to give back to the track the safety needed to guarantee the train traffic its normal speeds without slow speed orders.

Very often it is necessary to give a final lift, mainly in these cases that since the origin of the track have had a lack of ballast. We should always expect to have a minimum of 12″ of ballast underneath the ties. At N. de M. in some cases we have had from 8 to 10 years to make this second lift with an average of 4″, without the track suffering serious damage. We have to take in account, that a big amount of rocky material is incorporated to the embankment through 70-80 years of traffic and provides a sub-ballast layer.

In the specific case, of an improvement of the modern track all ready built, we will distribute again new ballast and we will again use a multi-tamping-leveling machine, followed by the track lining machine, single tamping machine, ballast equalizer and, in this case, the most important machine is the ballast compactor. It is very important in this case to have the group of machines as close as possible in order to eliminate the possibility of a track buckling effect due to the temperature stresses. The ballast equalize broom shall eliminate the excess from the top of the ties and the rail bases, which will permit the ballast compactor to do a good job which, as I said before, is the most important fact of this work, because it is going to compact the material between the cribs and in the shoulders, eliminating the possibility of horizontal and vertical displacements. Considering that we are using CWR we must not allow it to slide and perhaps fracture causing the need to be rewelded, with the inherent loss of time.

Maintenance Problems Must Be Faced

Once we have built this modern track, we will start to face the maintenance problem. In the stretches 15-year-old track, as in those recently built, we have observed that it is vital to have the fastening well greased and tightened and to try not to have a defective rolling surface which produces many troubles as we will see ahead.

As all of you know, actually more new sophisticated systems for integral track relaying exist, which, logically, are more expensive and require a very important number of high-trained and specialized personnel. They consume a big amount of material in a short time and require a reasonably long time on the track being worked, conditions that, at the moment, we can not have.

Testing Rail

Specifications of the manual of stand-

ards and recommended practices Part II items 4, the Brinell hardness number for standard rail, indicates 248 as minimum, the test shall be performed on a rail or a piece of rail at least 6″ long cut from a rail of each heat of steel.

In coincidence with this regulation the National Railways of Mexico have designed a procedure to test, the BHN, in the flash butt welded plant in San Luis Potosi and Monclova cities, rail by rail, as received from the rolling mill.

In this process, a portable electric grinder is used to clean the top of the head of the rail to ease the application of the BH tester.

The operator of the BH tester must be highly qualified and, when possible, must not be substituted by another untrained operator, in order to have uniform or homogeneous readings.

The records of the BHN obtained by means of a master bar make possible to select bunches of rails with differences of at least 5 BHN degrees, to be welded together and installed according to their BHN range, for instance, straight lines and sharp curves.

The BHN indicated, according to the comparative diagram of the test, is painted in the rail to be welded together, considering the request of the renewal of the rail program.

All the records must be filed by the engineer of the plant, for further references.

The records show the progressive number of the rail, section, class, process, year and month rolled, heat number, ingot number, rail letter, color, BHN and the qualification of the Bauman test.

The N.R. of M. are using today the Bauman test to make sure of the structural steel quality, free of segregation or other metallurgical flaws. The rail face is ground and an acid solution is applied.

A photographic paper previously treated is attached to the end rail face, and after keeping this paper fixed to the rail for two or three minutes, and then it is removed.

The operator can determine if the rail is usable.

If the web shows a heavy dark color, concentrated, the rail is rejected, not to be used on main lines, obviously, not to be welded.

It is easy, comparing the master image obtained, to be sure if the rail is to be accepted or rejected, considering the color or uniformity of the steel. When no structural flaws appear, and no probability for the rail to be deformed, supporting the heavy axial loads with trains running at maximum speeds exists, it is approved by the engineering department.

The gang makes a general inspection according to the facilities available and sometimes flaws are discovered on rails. These rails are separated and are to be carefully inspected by the engineer of the welding plant.

Rails in good condition are processed and passed to the flash butt welding machine, in which the operator checks the ends position to start the welding process.

All the burrs produced during the welding process are removed by fixed or portable grinding machines.

Rails ready for use, to be sent to a user, are put together according to their BH degree.

The records of BHN and Bauman test are sent to the Chief Engineers Office, the Division Engineer and Engineer in Charge of the renewal of rail operation.

When a modern track is finished and is ready to be put into operation, maintenance problems begin inasmuch as its elements are concerned. Let us consider this, in the Mexican Railroads we have around 3 and one-half million concrete ties, with welded rail, as can be seen in Chart 1.

I CWR RS CONCRETE TIE
II CWR DW CONCRETE TIE
III CWR STANDARD TRACK
IV CWR FRENCH RS FASTENING ON WOODEN TIES

We can see the location, Division, line, kilometers partial and total, year

MEXICAN RAILWAYS

I.— C.W.R.: "RS" CONCRETE TIE

	LOCATION	DIVISION	LINE	KM.	TO KM.	TOTAL	INSTALLED YEAR	CONCRETE TIE
1.—	SAN CARLOS — VILLA ACUÑA	MONCLOVA	RA	79+200	118+800	39+600	1959	63,360
2.—	MONTERREY — MATAMOROS	MONTERREY	F	9+000	182+300	173+300	1958	288,333
3.—	AHORCADO — VILLA DE REYES	SAN LUIS	GC	0+000	180+143	180+143	1967	288,033
4.—	CORONDIRO — LAZARO CARDENAS	PACIFICO	NE	0+000	183+100	183+100	1972	303,946
5.—	LOS POZOS — LOS MOCHIS	SIERRA TARAHUMARA	A	774+491	915+418	83+036	1958	137,939
						659+179		1'090,801

II.— C.W.R.: "DW" CONCRETE TIE

1.—	MEXICO — HUEHUETOCA	MX-ORO.	A	2+180	47+000	44+820	1967	71,712
2.—	IRAPUATO-FELIPE PESCADOR	CENTRO	A	554+000	815+110	320+280	1977	512,809
3.—	MEXICO — HUEHUETOCA	MX-ORO.	B	2+180	47+000	44+820	1967	71,712
4.—	VILLA DE REYES-SAN LUIS	SAN LUIS	B	488+720	522+480	36+780	1967	58,879
5.—	GOMEZ FARIAS — AGUA NUEVA	SAN LUIS	B	847+000	886+000	32+000	1949	53,120
6.—	ENCANTADA — SALTILLO	SAN LUIS	B	898+400	913+479	14+079	1945	28,020
7.—	SALTILLO — MONTERREY	MONTERREY	B	999+340	1,019+460	20+120	1969	59,431
8.—	MONTERREY — NUEVO LAREDO	MONTERREY	B	1,024+000	1,390+120	364+000	1973	590,022
9.—	CONEXION F y M	MTY. y GOLFO	F y M	0+000	16+000	16+000	1958	26,560
10.—	AMAPA — TRES VALLES	SURESTE-VCI	B	102+500	127+000	24+500	1943	37,084
11.—	IRAPUATO — PATTI	GUADALAJARA	I	1+000	104+500	71+038	1949	138,048
12.—	PATTI — YURECUARO	GUADALAJARA	I	111+000	115+300	4+300	1975	7,158
13.—	YURECUARO — SAYULA	GUADALAJARA	I	128+180	395+128	268+948	1969	432,887
14.—	ZAPOTILTIC — MANZANILLO	GUADALAJARA	I	438+315	441+459	2+144	1979	3,120
15.—	CIUDAD FRONTERA — AVANTE	MONCLOVA	RD	177+558	216+822	39+147	1973	64,294
16.—	TLALNEPANTLA — OTUMBA	MEXICANO	S	0+000	58+550	58+550	1953	85,008
17.—	JALAPA — VERACRUZ	JALAPA	V	335+989	488+148	152+227	1976	165,880
18.—	ALTAMIRA — LOS PLATANOS	GOLFO	M	9+000	44+227	35+227	1977	57,247
19.—	JALTOCAN — TEOTIHUACAN	MEXICANO	SM	0+000	22+958	22+958	1975	36,111
20.—	PASCUALITOS — RITO	FC.S.B.C.		0+000	72+500	72+500	1977	120,380
21.—	NOGALES — SUFRAGIO	SONORA		82+128	115+700	19+384	1970	33,137
22.—	SUFRAGIO — GUADALAJARA	SINALOA		1,180+210	1,883+700	9+620	1956	16,301
						1,545+964		2'450,635

III.— C.W.R.: STANDARD TRACK

1.—	CAÑADA — TOLOSA	CARDENAS	L	14+783	150+421	135+638	1972	271,278
2.—	OJO 2ARCO — LOS MORALES	CARDENAS	L	206+833	222+000	15+167	1972	30,334
3.—	ALONSO — SILOS	CARDENAS	L	227+000	275+110	48+110	1978	96,200
4.—	COMANJA — ZIRANDARO	GUADALAJARA	IN	95+100	103+800	8+700	1963	17,400
5.—	ACAMBARO — PARANGUITIRO	PACIFICO	N	283+938	477+150	193+212	1944	386,424
6.—	ACAMBARO — ESCOBEDO	PACIFICO	RB	0+000	84+324	84+324	1966	168,648
7.—	METEPEC — ORIENTAL	PUEBLA	V	58+625	218+000	159+178	1975	318,360
8.—	HUEHUETOCA — ARAGON	QUERETARO	B	47+000	134+515	87+515	1972	175,030
9.—	MARISCALA — IRAPUATO	QUERETARO	A	263+832	354+516	90+684	1967	181,168
10.—	TOTALCO — PEROTE	JALAPA	B	251+000	262+000	11+000	1966	22,000
11.—	MESA — ROSARIO	CHIH.-PACIFICO	A	367+329	437+531	54+687	1959	11,974
						839+412		1'678,804

IV.— C.W.R.: FRENCH R.S. FASTENING ON WOODEN TIES

1.—	HUEHUETOCA — ARAGON	QUERETARO	A	47+000	127+496	80+496	1974	160,992
2.—	COATZACOALCOS — TENOZIQUE	TENOZIQUE	A	0+000	400+000	400+000	1977	800,000
						480+496		960,992

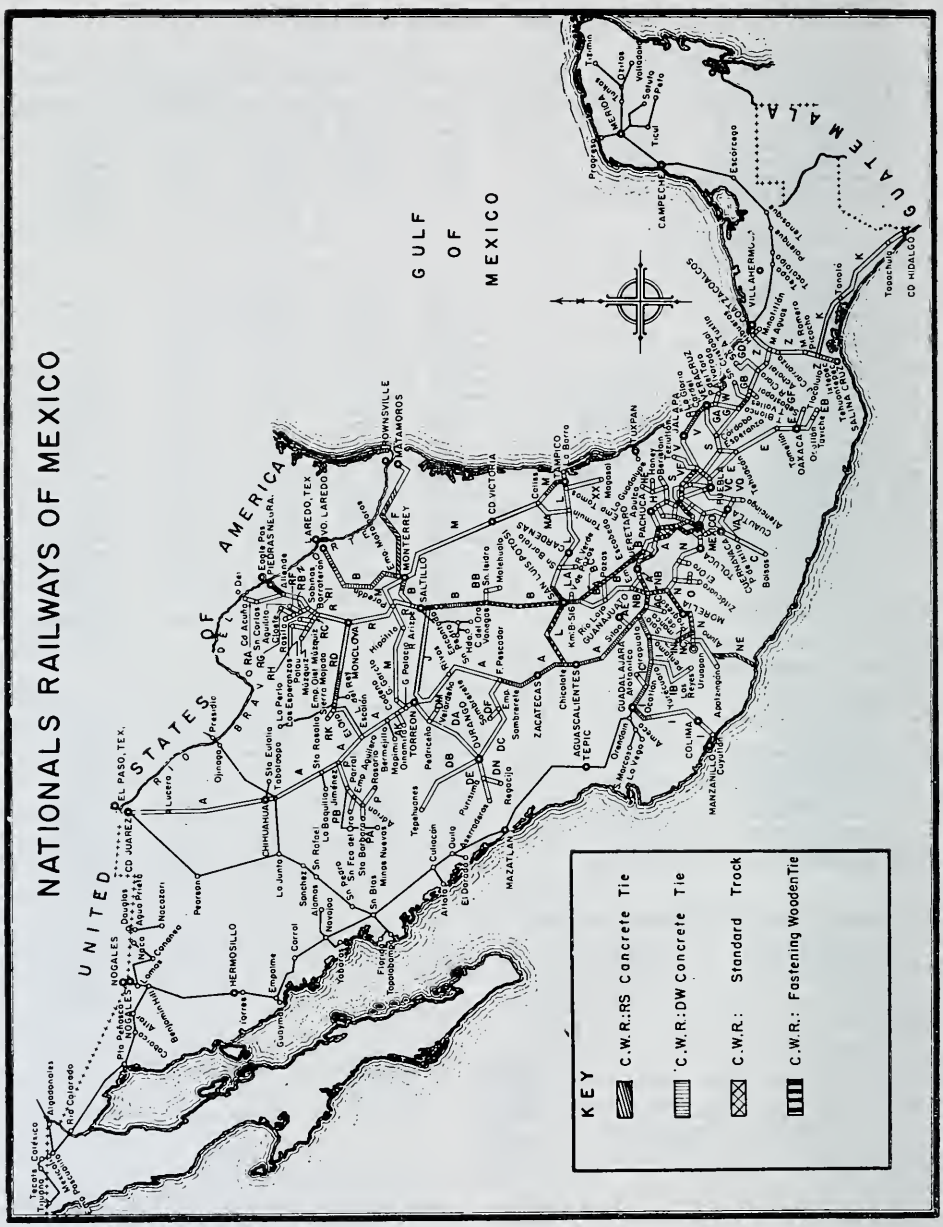
RESUME

			LENGHT	CONCRETE TIES	WOODEN TIES
I.—	C.W.R.	"RS" CONCRETE TIE	659+179	1'090,801	
II.—	C.W.R.	"DW" CONCRETE TIE	1'545+964	2'450,635	
III.—	C.W.R.	STANDARD TRACK	839+412		1'678,804
IV.—	C.W.R.	FRENCH R.S. FASTENING ON WOODEN TIES	480+496		960,992
			3'544+053	3'521,136	2'639,796

installed and quantity of ties as of today: 3,521,136 pieces.

A map of our country can be seen (Chart 2) showing the railway net, with four types of modern track, their locations and statistical curves, specially inasmuch as the National Railways of Mexico is concerned.

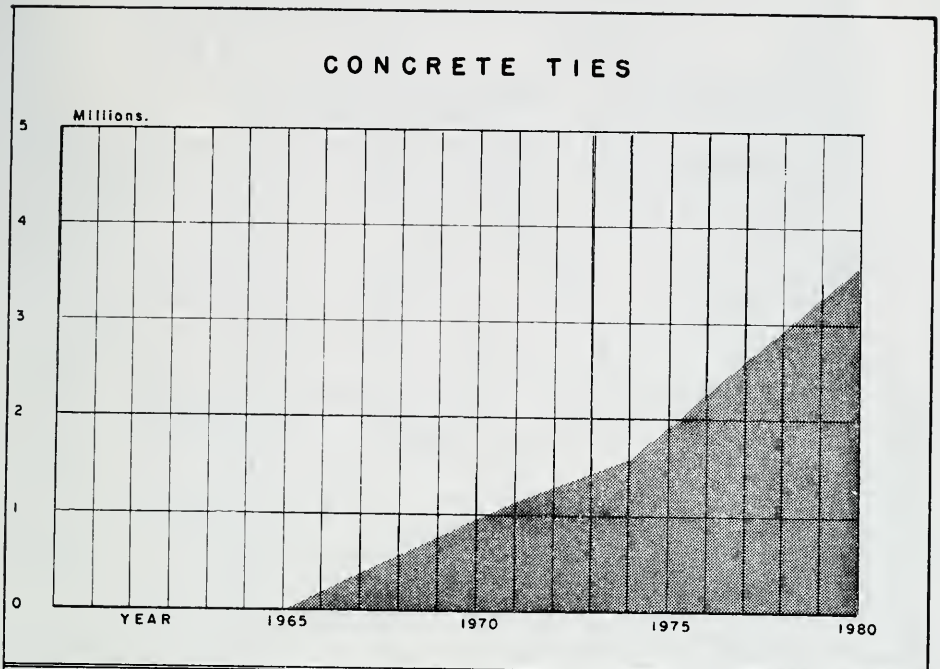
Statistical data have been prepared (Chart 3) showing defects currently found on concrete ties and their fastenings. In this detail (Chart 4), you can appreciate sections, lines, parts of track with DW and RS ties, defects on concrete ties which are in bad order or which have been taken out from serv-

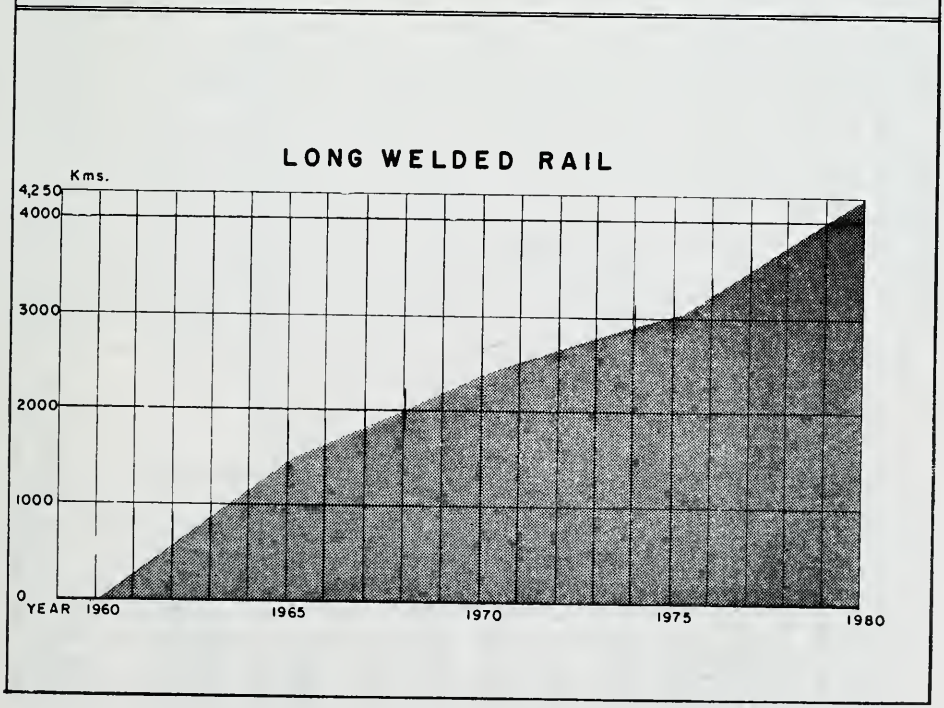


ice, with the exception that those being in bad order must be rejected but still are used to support rails and keep track within gauge limits. These ties are also used to support spring fastenings RS and SL bolts rubber plates, and cylindrical and trapezoidal cushions as well as insulating washers.

Percentage of damaged items can also be appreciated (Chart 5), concluding that the RS concrete tie has a total percentage of 1.16% against 0.61% of the DW tie; damages due to derailments is 0.39% and 0.07 % and 0.5% are the percentages for bad conditions.

The percentages assigned to fasten-


CONCRETE TIES
Millions.
5
4
3
2
1
0
YEAR
1965
1970
1975
1980


LONG WELDED RAIL
Kms.
4,250
4000
3000
2000
1000
0
YEAR
1960
1965
1970
1975
1980

NATIONALS RAILWAYS OF MEXICO

ACTUAL DEFECTS ON CONCRETE TIES

DIVISION	LINE	LENGTH		CONCRETE TIES				ELASTIC FASTENING		"RS" BOLTS		"SL" BOLTS		RUBBER TIE PLATE		CYLINDRIC RUBBER CUSHION		TRAPEZOIDAL RUBBER CUSHION		INSULATED WASHER	
				DW		RS															
		DW	RS	BO	R	BO	R	BO	R	BO	R	BO	R	BO	R	BO	R	BO	R	BO	R
CENTRO	A	326+260		3597	5				236		79		135		361	8370	1715	256	211		
GUADALAJARA	I	347+024		3116	105			3223	909	349	466	1100	47	1321	2082	852	91	338	709		
JALAPA	V	132+227												140	4			520	2		
MEXICO	A	23+454		1043				1377	9	1147	5			1590	38			1394		1109	
"	B	24+100		512				562		516				665	59			557	29	534	17
MEXICANO	S	59+550		849	356			2106	1655	2284	1806			1118	1029			1062	875	1074	1880
"	SH	22+958		171				684		684				342		342				884	
MONCLOVA	RD	39+147		530	1			1949	1210	1000	577								20		
"	RA		39+600			8		76		964	76							389	99		
MONTERREY	B	264+120		1644	389		346	1906	3086	136	2809	1959	655	339	1507		1971	222	1971		
"	F		173+300	174	121	291		26	136	10	152			5	164			3	350		
QUERETARO	A	23+546		138				10	4					1223							
"	B	20+900		722				1400		1030				3770	1000	800		1200		3120	
SAN LUIS	B	65+659		1050				175	14	149	113			474	137			114	104	13	73
"	BC		180+143	118	107	6046	51	5198	507	32	19	5382	505	20	261			24	355	5221	558
SURESTE-VCI	G	24+500				900		194	45	72	26			169	53				155		
		1,415+425	393+043	13,668	1,084	7,235	397	18,909	7,913	8,373	5,928	8,441	1,342	11,184	6,675	10,164	3,777	8,234	4,725	11,754	2,328
TOTAL		%		0.57	0.04	1.10	0.06	0.20	0.08	0.08	0.06	0.08	0.02	0.23	0.14	0.18	0.04	0.10	0.06	0.09	0.01
DERAILMENT INJURED		%		0.07		0.39		0.08		0.06		0.06		0.03		0.03		0.02		0.06	
BAD ORDER		%		0.50		0.71		0.12		0.02		0.02		0.20		0.13		0.08		0.03	

KEY:
IN BAD ORDER
(INCLUDING DERAILMENT INJURED) = "BO"
RETIRED = "R"
1 KM. = 1666 CONCRETE TIES

NATIONALS RAILWAYS OF MEXICO
EXAMPLES OF DEFECTS CONCRETE TIES INSTALLED

	GUADALAJARA DIV. INSTALLED 1971-1973 175 MILLION GROSS TON. "I LINE"		SAN LUIS DIV. INSTALLED 1968-1970 200 MILLION GROSS TON. "BC LINE"	
CONCRETE TIES "DYWIDAG"	431,494	%	8,299	%
BAD ORDER	1,119	0.25	118	1.42
RETIRED	105	0.02	107	1.29
DERAILMENT INJURED	334	0.07		
	1,558	0.34%	225	2.71%
CONCRETE TIES "RS"			290,723	
BAD ORDER			5,471	1.19
RETIRED			51	0.02
DERAILMENT INJURED			2,575	0.89
			8,099	2.10%
ELASTIC FASTENING:	1'725,976		1'196,088	
BAD ORDER	1,969	0.11	584	0.05
RETIRED	746	0.04	507	0.04
DERAILMENT INJURED	0	0.00	4,614	0.39
	2,715	0.15%	5,705	0.48%
"RS" BOLTS	1'725,976		33,196	
BAD ORDER	258	0.01	32	0.09
RETIRED	388	0.02	19	0.06
DERAILMENT INJURED	10	0.00		
	656	0.03%	51	0.15%
"SL" BOLTS			1'162,892	
BAD ORDER			589	0.05
RETIRED			505	0.05
DERAILMENT INJURED			4,793	0.41
			5,887	0.51%
RUBBER TIE PLATE	862,988		598,044	
BAD ORDER	725	0.08	28	0.01
RETIRED	1,783	0.20	281	0.04
DERAILMENT INJURED	0	0.00		
	2,508	0.28%	289	0.05%
TRAPEZOIDAL RUBBER CUSHION	862,988		581,446	
BAD ORDER	338	0.03	24	0.00
RETIRED	709	0.08	355	0.07
DERAILMENT INJURED	0	0.00		
	1,047	0.11%	379	0.07%
INSULATED WASHER			598,044	
BAD ORDER			29	0.00
RETIRED			558	0.10
DERAILMENT INJURED			5,192	0.87
	—	—	5,779	0.97%

ings and their components, plates, cushions, etc., are rather low, enabling us to see a promising future on the track built this way, provided the increasing of load per axle comes to an end.

Speaking of locomotives and rolling stock, the regulations on maintenance of wheels must be up-dated, so tapering and contours of wheels can be more easily brought close to their original conditions. Consequently, the steel for wheels, its Brinell hardness, must be more suitable for the rails, of similar properties. It is quite improper to think of a rail having a 248 BHN to support loads of 80,000 lbs. per axle, even at low speeds, such loads, transmitted through wheels of 350 BHN, have resulted in waves of the top of the rails and in the approaches of welded joints.

These were built electrically in a shop, or by means of the thermit process in the field.

Such waves are easily detected on the rail approaches as well as in the welt joint itself, resulting in tremendously heavy impacts, in the order of 200% or 300%, which interact in this plastic deformation and premature distortion in the new rail, subject to severe plastic flow and deformations which must be repaired or eliminated by means of coatings of proper welding and grinding, to restore the rolling surface. Obviously, this work can not be done in a perfect way and the small flaws lead to more serious interaction and formation of curlings as long as the rail is in service.

With this serious problem in mind, the National Railways of Mexico is making great efforts in order to get the control of the uniformity of the rail hardness before it is welded, noting the defects such as pipes, segregations and others, which contribute to distort prematurely the head of the rail.

An example of defects found in the concrete ties is shown precisely in two track sections, one of them in the Guadalajara Division and the other in the San Luis Division, with 7 to 9 years and 10 to 12 years of service, with 175 and 200 millions of gross tons. Percentages are also shown for said time periods, indicating the ties in bad order but still under operation, ties already eliminated but which must be replaced and the ones damaged due to derailments.

It can be observed precisely here that DW ties percentage is very low in comparison with the RS, starting with the most significant figures, which are as follows: 431,494 DW ties, with 0.34% in "I" line with 175 millions of gross tons transported in 7 to 9 years, and 290,723 RS ties with a percentage of 2.1% in 200 millions of gross tons, from 10 to 12 years in service in the "BC" line, which also has 8,299 DW ties with 2.71% of failures.

This significant difference is due to the signalization of line "BC," which is not the case of the "I" line. Heavy distortions are founded in all insulated joints as well as in the approaches, leading to a premature wear of the concrete tie. The BHN of the rail play a very important part because in the starting time of this net work, that hardness was not controlled and the specification for rail welding was poor in comparison with actuals. Any way, it is possible in the near future to reduce the damages described above and other interactions, that ultimately make these damages more serious; and for this purpose, new practices are being adopted in our welded rail facilities. On observing the percentages of the example, it can be seen that on a 10 year term, probable consumption of ties can be less than 0.3% per year and will never reach 0.1% per year in the rest of fastenings and fittings of this type of track, provide speed, loads, etc., are kept within limits.

In my opinion, these figures are highly stimulating for the economy and performance of my company, expecting great improvements in the operation of our equipment due to the use of this modern track.

Civil Engineer, graduated from the National University of Mexico.

Specialist graduated in Highway and Track Engineering, Physicians Department.

Soil Mechanics Cost and Applied Machinery to Highway and Track Construction. National School of Engineers. Engineering Research in the same University.

Association Professor, A. S. D. N. E. F.

Professor, Advanced Studies Division, National Engineering Faculty.

AREA, ACI, RM&MW Assn. member.

Life member of the Civil Engineering College.

Mexican Seismic Society, founder.

Mexican Highway and Track Society, founder.

1944-1948 National Railways of Mexico, Junior Engr., Assistant Engr. in

Technical, Scale, Track, Building, Yards and Terminal Sections.

1949-50 1953-59 Pacific, San Luis, Cardenas and Mexico, Division Engr.

1950-52 Structural, Shops Engineer in Nuevo Laredo Terminal construction.

1959-64 Chief Engineer, Track & Accidents Section.

1964-66 Asst. Chief Engineer.

1966-68 Asst. Sub-Manager of Track and Structures.

1968-70 Asst. Sub-Manager of Track and Structures to Telecommunications & Signals.

1971-73 Retired.

1973-80 Chief Engineer, National Railways of Mexico.

Engineering Railroad course on Northwestern University, Evanston, Ill., and George Washington University, Washington, D.C., Relationships Accounting and Business Administration in the Training of National-Railways of Mexico.

Attendant to several Congress, Convention, Seminaries, Conference Studies and Research, U.S.A. and Europe.

Mr. Hernandez: Thank you, Mr. MacNiece. Unfortunately, we had the film break, the lights out, and so forth. Mr. MacNiece does carry a heavy accent, however, his speech was well illustrated in the film and the slides, and he also has a report that has been typewritten.

Now, he is open for questions. If you have any questions which you wish to ask now or later, feel free to do so.

Thank you very much, Mr. MacNiece for a good presentation. Mr. Gale.

President Gale: Thank you, Mr. Hernandez. Thank you, Mr. MacNiece, and Mr. Van de Water.

I would now like to call on 1st Vice President, Mr. Ben Sorrels, District Engineer, Santa Fe, Amarillo, Texas, to introduce our next speaker.

Mr. Sorrels: Thank you, Mr. Gale. I have known Mr. Kelly for a number of years. It is with great pleasure that I introduce him to this Association.

Mr. Kelly attended New Mexico Military Institute at Roswell, New Mexico, from 1942 to 1946, and attended Oklahoma University at Norman, Oklahoma, from '46 to '48, and has taken post graduate work at Harvard from 1949 to '50.

He served as a 1st Lieutenant in the U. S. Army in the Korean campaign.

Mr. Kelly is President and Chairman of the Board of the American National Bank of Bristow, Oklahoma, and Chairman of the Board of the Citizens State Bank of Okemah, Oklahoma.

He serves on the Advisory Council of the Small Business Association and is a Director on several corporate boards in Oklahoma and Missouri.

Mr. Kelly is active in church work and numerous civic organizations.

This Association had the pleasure of having Tracy Kelly at our 89th Annual Conference in 1977 and it is a pleasure to welcome him to our 92nd Conference.

Mr. Kelly (Applause)

Inspirational Address

By TRACY KELLY

President, American National Bank, Bristow, Oklahoma

Tracy Kelly

Thank you very much, Mr. Sorrels. I appreciate the invitation to be here.

I notice according to the program I am supposed to be inspirational. I think the most inspirational thing I could do now is request that you all stand up, please, and remove the fabric from your posterior.

Stand up—put your hands over your heads, please—stretch—and come back and clap three or four times. Now you may be seated. Thank you.

You see, my deal with the Program Committee—I was supposed to get a standing ovation. Contract fulfilled.

I did not know I was going to be on such an international panel this morning. You know, Canada—Mexico—and poor little Oklahoma. Where I come from, a little village in rural Oklahoma—international affairs is a girl friend in Dallas. So, I am complimented to be among your company with such international fame.

School is Never Out For the Professional

The first thing I want to do, gentlemen, is to congratulate each one of you for being here, for being involved, and for being the kind of railroader whom the company deems important enough to spend more money on to bring here to these kinds of conferences.

Wood burns because it has the right stuff in it. You are here because you have the right stuff in you. You are worth investing money in. For that I salute.

You know, school is never out for the professional. I am reminded of the story they tell of Alonzo Stagg, 80 year old coach. He flew from Los Angeles to St. Louis one day, to a Coaches' Convention. A young coach said, "My, My, Coach Stagg, my goodness, what are you doing traveling half way across the country to another Coaches' Convention?"

He said, "Son, if I can get one play that will make a touch down, it will be worth my time."

School is never out for the professionals.

An old Hindu proverb says, "Nobility is not being superior to your neighbor. True nobility is being superior to your previous self."

Anything you can do to improve your previous self is a noble undertaking. For that I appreciate your involvement.

As I understand, you Roadmasters and Bridge Builders are responsible for the maintenance and the safe and good operating order of all the trackage. I have been impressed with these slides and presentations. To me, that seems like an awesome assignment. I need not remind you professionals of the critical nature of your job. You live with it every day, and have for years. I have concluded that without you the railroads do not move.

I am reminded of three umpires down in Oklahoma. They were pretty proud of their ability to call a game. One of them said, "You know"—he was very proud of this—"I call 'em the way I see 'em." And the second one said, "I call 'em the way they is." And the third one said, "Hey—they ain't nothin' 'til I call 'em."

So, that is the way I feel about you Roadmasters—the railroads ain't nothin' until you put them on there and keep them on the track. Without the sound footing and foundation provided by you Roadmasters, the railroads cannot go. I salute you for that.

Bloom Where You Are

I suppose you are wondering why a country banker from Oklahoma is here and what he is doing at a railroad convention in Chicago. Well, I am more than a banker from Oklahoma. I am a child of God. This morning for a few minutes I want you to think with me about that with a prayer that you can perceive yourselves as more than a Roadmaster, more than a Division Engineer, more than a B&B personnel, that you, too, are a child of God. Because, you see, I think that puts everything else in perspective.

I will guarantee you, my friends, if you approach your work day with that positive affirmation you will bloom where you are. So will everything else around you, including your railroad, your family, everything. You do not need to wait until you get another promotion to start doing your blooming, your thing.

In my judgment, the problems we have in our society, in our banks, in our railroads, are more spiritual than they are physical. We have been seeing many graphs, many numbers, technical in nature, certainly. These are musts. But I say this whole thing needs to be couched in a moral and spiritual context. It depends, I think, on your attitude about people.

We have an expression in our bank that all banks are alike—excepting the way they treat people.

I was delighted to hear the Canadian representative this morning, Mr. Van de Water, remark that in his opinion the greatest dollar they could spend is on training. You have to upgrade the person. The person is the delivery system in any activity. Your attitude about people will determine your performance from the chief executive officer right down to the person doing the work. Your attitude about your fellow man, your inner motives, empowered by God, enable us voluntarily to care, to be just, yes, to bloom, to have better lives.

Your life is your message. He that can take a city is not as great as the one who can take care of his own life. If you can take charge of your life, to genuinely care about others, I will guarantee you that the welfare of the people under your supervision will reflect itself in superior performance.

The production in your department will surpass all previous records. I am excited to hear words like "productivity." Your absenteeism will be reduced and you will get more things done with it with less hassle.

People Are Something Special

Why? Because of your attitude about those people. Because people are something special. They will be constrained to respond and will want to please. Believe me, if you have the attitude that everybody is somebody, not just politically climbing the corporate ladder, for anybody who does not want to exploit people is salvageable. They have great

promise. I think with the influence leaders in this room have with their respective companies, if they will show that kind of respect, the old cliche that says, "The people respect what the boss inspects," if they will respect those things, it will show.

Your attitude will determine your altitude. Your life will automatically reflect that dynamism.

We need to encourage all our people to strive for excellence and bloom where they are planted.

One of my peeves is the old syndrome, "Well, it is good enough for who it is for." Have you ever experienced a work crew that just did that kind of mediocre assignment? "Well, it is good enough for who it is for."

A Biblical exhortation says, "Whatever your hands find to do, do it with all your might." How important it is to be willing to go the second mile.

In the great parable of the talents, one of my very favorites, Jesus is very condemnatory of the person who sat on the talents and did not perform. To the ones who did perform on their talents to use them, more will be added. Very generous.

I saw a bank slogan one time. "Your full service bank—and then some." It is that second effort which counts. Since we have only one time around, gentlemen, you do it right. That is enough.

Your very lives can change the whole concept of your office and your work force, by your mental attitude. God has already equipped you. You must have a great deal of talent or you would not be selected to be in this select group. I am sure you do everything you can to try to get a cooperative spirit for greater efficiency and greater productivity.

I am reminded of a little poem. Even the horses knew how to cooperate and the poet put it in a very succinct, dramatic way. He said:

"When days are hot and flies are thick,
Use horse sense—cooperate.
This is a truth all horses know.
They learned it many years ago.
One tail on duty in the rear,
Can not reach that fly behind the ear.
But, two tails when arranged with proper craft,
Will do the job both fore and aft."
Cooperate.

Free Enterprise Major Contributor To Public Interest

Now, very briefly I want to say something about the vitality and dynamism of our free enterprise system. I think I would be remiss if I did not. If you will, take advantage of an opportunity to talk about enterprise, the thing that, to me, enlightened business needs desperately to tell more about. Because I think enterprise is a major contributor to public interest.

Before we were business men, before we were railroaders, Roadmasters, parents, B&B personnel, we are, first, as I said, children of God. Citizens of a free society. As such we bear certain responsibilities. One of those is certainly public service. You ladies and gentlemen here epitomize your lives in public service. Life is entrusted in your hands every day. You are responsible for that. You are on the cutting edge.

Aristotle said about 2,000 years ago that one citizen may differ from another but the salvation of the community is the common business of us all. This is to what I want our total citizenry to be more sensitive and to be more aware of, for it is the common business of us all.

You are in the fortunate and satisfying position of being able to bring about a good many of society's aspirations and practical realities because of where you are. I think it is incumbent upon each of you to educate your own constituents where you have influence, to get at your brush, your style, your philosophy. A day's work for a day's pay is a moral issue, and not a collective bargaining issue. Where is your style? Where is your influence? Where is your morality?

Now, one element of our business system that is frequently misunderstood and for which we sometimes even apolo-

gize, serves the public well, helps him measurably to build a better society, delivers far more to the public good every day than all the other public services of business put together, is the profit motive. It is one of the greatest instruments of public service ever devised. It merits much greater recognition for the public service it performs. Increasingly, it seems to me, the leaders of our business community, you railroaders included, try to justify our companies by referring mainly to their good works, in aiding education, in helping to solve social problems and in serving our communities in a great variety of ways. Such good works are important. I am not knocking that at all. However, one cannot organize the economic activity of the nation based solely on altruism, good works or volunteer public service. Too often, it seems to me, we shy away from talking about how dynamic a force the profit motive works to build a quality of life, a better society. We practice capitalism, yet we are reluctant to preach it.

We cannot discharge our community responsibility unless we make a profit. You Roadmasters and B & B members need to address yourselves, in my opinion, to the source of the pay check as it relates to the future of your job.

Take this message, if you will, to your people. Without a profit, you do not have a job. That comes painfully true to me, coming from Oklahoma, having just witnessed the demise of a great railroad, the Rock Island. Many of my personal friends are unemployed this morning because they did not keep their eye on the right target. Without profit, gentlemen, you can not have a job.

That is why I am such a nut on it. I am here to champion profit. It is the heart of the free enterprise system. Profit is not unwarranted gain. Profit is that uncertain residual that goes to the owner of a business after everything else is paid. You take profit out of our system and you have gutted it. Serving the public and seeking profit reinforce each other. They are mutually supportive.

History shows that man owes his greatest material advantage to freedom. Destroy the profit and you have destroyed our greatest freedom. I believe this in the marrow of our bones, when we are getting elements across this great and good land of great influence, saying, "Equality — equality." That equality does not mean sameness. Our country prides itself and has become great in the concept that man succeeds by performance, by productivity, not by circumstance of his birth.

Plenty of pressures are in a democracy to move further and further in the direction of sharing rewards regardless of individual performance. "Share the wealth" programs have considerable political appeal right now and because of these pressures one sees a growing tendency towards the philosophy "to each according to his needs and from each according to his ability."

Nothing is wrong with this philosophy except it will not work. One of my favorite quotes is what Winston Churchill said about capitalism. He said, "The inherent vice of capitalism is the unequal sharing of blessings. But the inherent vice of socialism is the equal sharing of misery."

Never in the history of humanity has so much been shared by so many in this country in our free enterprise system. We need to fine tune it and orchestrate it but we do not need to scuttle it like it has been done. I think men of influence in this room can do something about that in your constituency.

How is it at your breakfast table, in your office, in your company?

You know, Will Rogers said about all of our aiding foreign countries, and so forth, "You know, they never hate us so much that they do not quit using us."

Free Enterprise System A Rich Inheritance

Our great American free enterprise system is not a gift from God, but a rich inheritance painfully built by men. Our forefathers built a rich heritage for us, a legacy of love, and industry, and

high courage. We show our gratitude and gratefulness to those forefathers by honoring this heritage and passing it on, strengthened and reinforced to those who come after us.

One of the over-riding tasks of our times, it seems to me, is to inculcate in our young people a firm belief in our free enterprise system. We can hardly expect our system to survive for another generation if the coming generation does not believe in it. If our system is to survive, we desperately need their understanding and their support.

One of the great problems in this country right now is the economic illiteracy of our people. Perhaps the greatest fraud in all of history, as far as American history is concerned, is what the government is doing to its constituents regarding the fiscal irresponsibility. All the money you gentlemen are piling up in your pension fund is being eroded because of the physical irresponsibility of government.

It has nothing to do with party. It has everything to do with our constituent economic literacy. As a banker, I am constrained to say this. I have no other choice. With more and more government intervention, it is continually a mystery to me why the public is apparently more trustful of the motivations of people in government than the people in the private sector.

When I was a kid, one in twenty-six worked for the government. Now one in six work for the government.

You know, after all of the issues of the day, the gay liberation, the ERA, the Cuban crisis, the Iranian crisis — after all that is behind the boards—we still have the responsibility of creating a quality of life for people. This is where I would like very much to see where you can be committed to doing your part in improving the quality of life where you are, where you are planted. Because, when you do this, your brush will automatically improve the performance of your railroad. It is inevitable.

Ultimately the restraint against corruption and the fiscal irresponsibility of our government, whether in government or business, will depend upon the moral character and fiber of you and me. Therefore, on the ethical and spiritual underpinning of our society and our culture, we must live in the faith, gentlemen, that right will make might. In that faith let us dare to the end to do our duty.

God speed. (Applause)

President Gale: Thank you, Mr. Kelly. That was very good.

Next on our program we have Mr. J. J. (Jack) Burke, Manager of the Railroad Products, CF&I Steel Corporation, who will present a film.

Mr. Burke is Manager of the CF&I Steel Corporation in Pueblo, Colorado.

He has a B.A. degree from Loyola University of Chicago, Rome, Italy, in Art. He has a M.B.A. degree from Loyola University in Marketing.

Mr. Burke's career has been an extensive background in the steel industry. He started with the CF&I Steel Corporation in January, 1977, and has been employed there up until the present time.

From January, 1977, to February, 1977, he was Assistant Manager of General Sales.

From 1977 through February, 1978, he was Assistant Manager of Railroad Products.

From February 1978, to the present, he has been Manager of Railroad Products.

Mr. Burke belongs to the following railroad associations:

A member of the Railroad Engineering Maintenance Suppliers Association.

An Associate member of the American Railway Engineering Association.

He is a member of the Pacific Railway Club.

He is a member of the Roadmasters and Maintenance of Way Association of America.

He is Chairman of the Railway Progress Institute Committee of Maintenance and Engineering.

Mr. Burke. (Applause)

Modernized and Expanded CF&I Rail Facility

By J. J. BURKE

Manager, Railroad Products, CF&I Steel Corp., Pueblo, Colorado

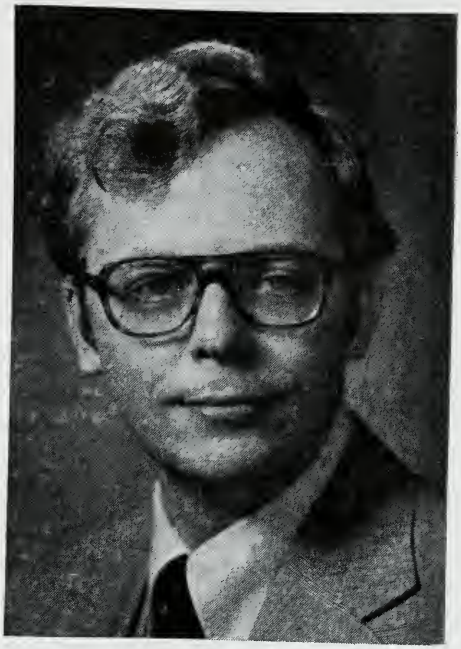
Mr. President, ladies and gentlemen:

On behalf of CF&I Steel I wish to thank you for your kind invitation to participate in these 1980 Conferences.

We, in Colorado, certainly consider it both an honor and a privilege to be able to bring you up-to-date on our recent rail mill expansion and modernization.

Trying or attempting to speak to a group of railroad engineers about rail is, to use an old cliche, somewhat like the preacher trying to preach to the choir. It is even more awkward in a situation like this today, speaking to a group of experts in the field.

We do, however, welcome this opportunity since we at CF&I want you to know how we feel about these Associations, the railroads, the railway industry in general and the role that we as suppliers can fill in the resurgence of the railroads during the 1980's.



J. J. Burke

Best Rail Facility in The United States

As you are probably aware, CF&I launched the largest single capital expenditure in our history to improve our rail facilities back in 1977. During the ensuing two and one-half years we proceeded to add many new pieces of equipment which you will see in the film in a few moments, and which has provided us with the most modern rail facility in the United States.

The total cost of this expansion and modernization was well over $100 million. Today our capacity has increased by over 50%, to 550,000 tons annually.

With this improved facility we at CF&I have continued to reinforce our strong commitment to your industry. Railroad products account for over one-third of our total plant shipments.

Benefits of New Facility Many

In our judgment, and that of our customers, the benefits of this new facility to the railroad industry are many. Besides having an increased supply of high quality rail at your disposal, you can now buy long rail, up to 82 feet, which will reduce the number of welds in your track structure and save substantial dollars in welding cost.

Currently, we have only four customers for our long rail, accounting for approximately one-third of the rail we produce. We feel that more roads will

be utilizing long rail in the coming years as the necessary capital dollars are obtained by engineering departments to change over their centralized welding facilities.

Another advantage is our roller straightener. The straightener is the largest in the world and the only one of its kind in the United States. As you will see in the film, it is a much improved way of straightening rail. Rail welding plants utilizing these roller straightened rails have reported dramatic increases in weld plant productivity because of the improved straightness of the rail.

The straightener has also allowed us to implement the development of our newest rail—Chromo-rail. This new rail is so durable that we had considerable trouble straightening it in our old gag presses and had to install the 2-plane rotary straightener. We feel that this new ultra-high strength rail, which is designed for severe curves in track, is the premium rail of the future. The rail is not only tough and durable but can be welded in only a few seconds longer than it takes to weld standard carbon rail. This is a big advantage over premium alloy rails that have been developed in the past and are currently available.

But to tell you more about and to let you see the new rail facility, we have produced a new film entitled, "Rail For The Long Haul," which tells the whole story of manufacturing rail.

Railroads Basic Part Of Nation's Economy

The story starts at our mines and winds through to where we finally finish and ship the rails. We sincerely believe that an additional investment such as this by railroads and suppliers will pay healthy quality dividends in the future, the development of better, stronger track for moving vital materials.

With our railroad background, we at CF&I share with you the frustrations and achievements within the industry, not only as friends, but as responsible fellow business men. From our point of view, the railroads have been, are, and will continue to be the prime and basic part of our nation's economic fabric.

Again on behalf of CF&I, let me thank you for your kind invitation and attention. I would like to point out that this movie, "Rail For The Long Haul," will most gladly be made available to any railroad in this audience who might choose to use it for any educational or training purposes.

Thank you again.

(Mr. Burke presented the movie)

(Applause)

President Gale: Thank you, Mr. Burke. That was a really educational film.

Do you have anything to add, President Gould? We are running a little late. Our program this afternoon is supposed to start at 1:15 but we will set it back to 1:30. We will stand adjourned.

. . . Recessed at 12:08 P. M. . . .

TUESDAY AFTERNOON

September 16, 1980

1:15 P.M.

President Gould: The meeting will please come to order. The second meeting of our 85th Annual Conference is now in session.

Each year we look forward to meeting friends and making new acquaint-

ances. Even more so we look forward to greeting our Association's Past Presidents. To introduce these esteemed gentlemen who are with us this afternoon, is immediate past president, Mr. W. C. Sturm. Will Mr. Sturm please come forward to make the introductions?

Mr. Sturm: Thank you President Gould.

It is with gratification that I announce that eleven past presidents of the Association are in attendance today. It is an indication of the dedication these gentlemen have had for the Association that they still maintain an active interest in the affairs of the Association. I am sure we can all benefit from their experience.

Will each of you gentlemen please stand, and remain standing after your name is called?

The following past presidents are in attendance this year:

W. H. HUFFMAN	(1957-58)
M. H. DICK	(1958-59)
H. M. WILSON	(1965-66)
R. D. HELLWEG	(1966-67)
W. F. ARMSTRONG	(1967-69)
N. D. BRYANT	(1972-73)
E. E. RUNDE	(1973-74)
J. R. WILLIAMS	(1975-76)
W. H. RANKIN	(1976-77)
J. R. IWINSKI	(1977-78)
W. C. STURM	(1978-79)

On behalf of the Association and me, thank you for attending.

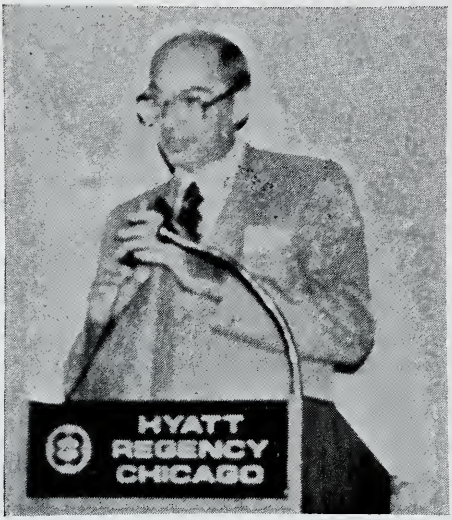
Mr. J. M. Williams will please come forward to introduce our next speaker.

Mr. Williams introduces Mr. J. C. Hobbs, Chief Engineer, Richmond, Fredericksburg, & Potomac, of Richmond, Virginia.

Four Mile Run Flood Control Project

By J. C. HOBBS

Chief Engineer, Richmond, Fredericksburg and Potomac Railroad Company



J. C. Hobbs

The RF&P Railroad operates between Richmond, Virginia, and Washington, D.C. Potomac Yard is located just outside of Washington and is owned and maintained by the RF&P and serves many railroads: From the north, Conrail, Delaware & Hudson, and the B&O portion of the Chessie System and from the south the C&O portion of the Chessie System, Southern Railway and the RF&P which handles all of the southbound traffic to the Seaboard Coast Line.

I will try to give you a quick overview of this fifteen-year project in just fifteen or twenty minutes. Therefore, I will have to leave out many details and talk mostly in generalities. I apologize for the fact that most of my slides are black and white but as you will later hear, this project ran into financial problems, and one of the ways to cut costs was to have black and white photos instead of color.

The Four Mile Run Flood Control Project was instigated to relieve the flooding situation on what used to be a very small creek in Alexandria and Arlington, Virginia, immediately south of Washington, D.C. Four Mile Run Creek drained an area of nineteen square miles into the Potomac River.

In the 1930's the area was barren, undeveloped and extremely swampy. Part of the original culvert was constructed in the early 1800's.

As the area had developed over a period of thirty years, the run off was greatly increased and the culverts under the RF&P's Potomac Yard became inadequate. In the early part of the 1960's the railroad, along with the Corps of Engineers, began to work together for a mutual solution to the problem. In the latter part of the 1960's the Corps of Engineers accepted the Four Mile Run channels as a Corps of Engineers flood control project. In the early 1970's an agreement was reached between the Corps of Engineers and the railroad by which the railroad would design and construct structures to carry the railroad over a new proposed Four Mile Run channel at the Corps of Engineers' expense with contributions from the railroad and local governments.

Slide 4

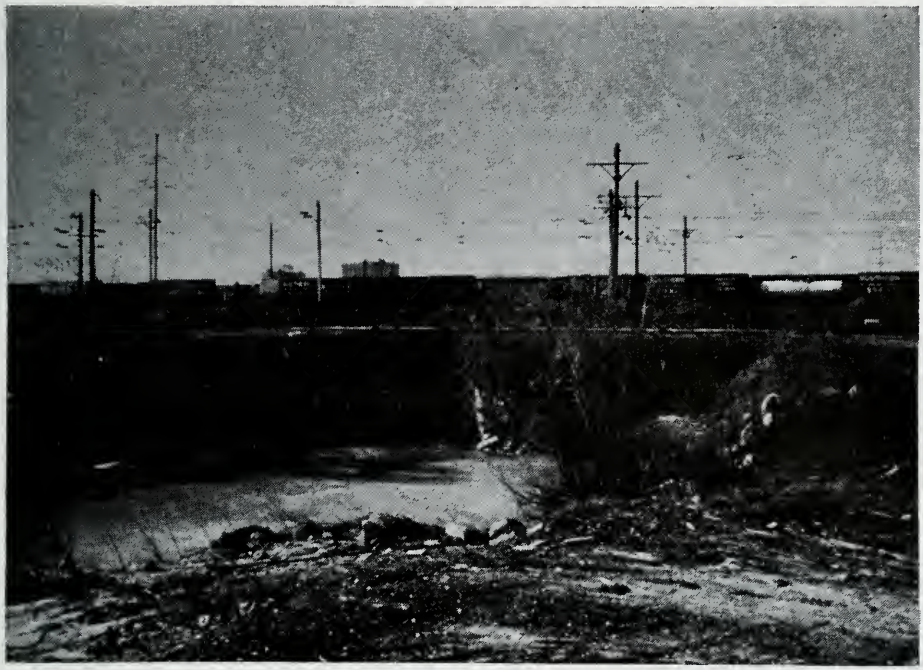
The original structure consisted of twin twenty-foot arch culverts constructed at various times of stone masonry, brick masonry and concrete.

Slide 5

Also, a temporary trestle carrying nine tracks had been built during World War II and further complicated the drainage of the area.

Slide 6

The proposed new channel was to



SLIDE 4

SLIDE 5

have a channel bottom width of two hundred feet. As you can see in the top part of this slide, the original double twenty-foot arch culvert ran at an angle across the tracks and the centerline of the new proposed channel bi-sected the old culvert at approximately its mid-point in length, creating challenges to construction.

The World War II nine-track timber trestle can be seen at the bottom of the slide to the north of the new channel, however, not quite far enough north for it to remain during construction of the new bridges. In addition to the two hundred-foot wide channel bottom, on one side of the channel a bicycle path was constructed. On the other side of the channel, the railroad required a pedestrian walkway for its employees to safely have access from one side of the yard to the other. The total length of the bridge structures thus became approximately two hundred sixty-eight feet as compared to the forty feet of the original culvert.

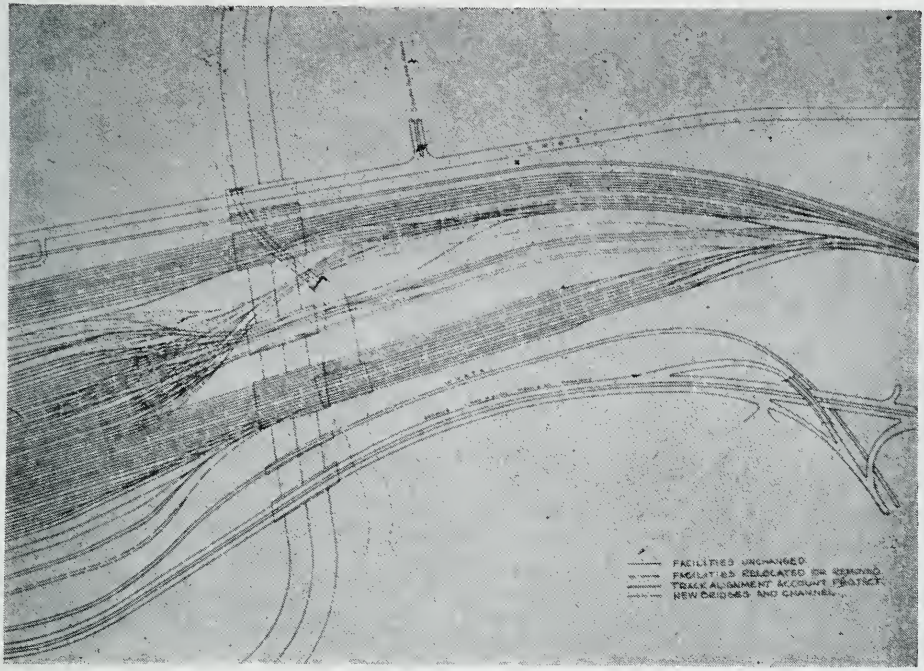
The railroad contracted DeLeuw Cather Associates in the early part of 1970 to begin the design phase of the railroad's portion of the flood control project. Many factors had to be considered in addition to the design of the project for flood control purposes only, but, the major of these was the necessity for all the Potomac Yard Railroad operations to continue during the entire construction process.

As you can see, the configuration of the yard was changed in order to facilitate construction, black being the original track layout and red the new track layout. At the extreme top of this slide is U.S. Highway 1. Just under U.S. Highway 1, the two tracks shown in red are the two main line passenger tracks which, because of alignment and proximity to U.S. Highway 1, had to be maintained over the new structure without re-alignment. A temporary run-around was constructed in order to build the main line bridge and the tracks were then shifted back onto the new bridge. Just below the two main line tracks is the South receiving yard. It should be noted at this point that Potomac Yard consists of two humps, one for north moves and one for south moves.

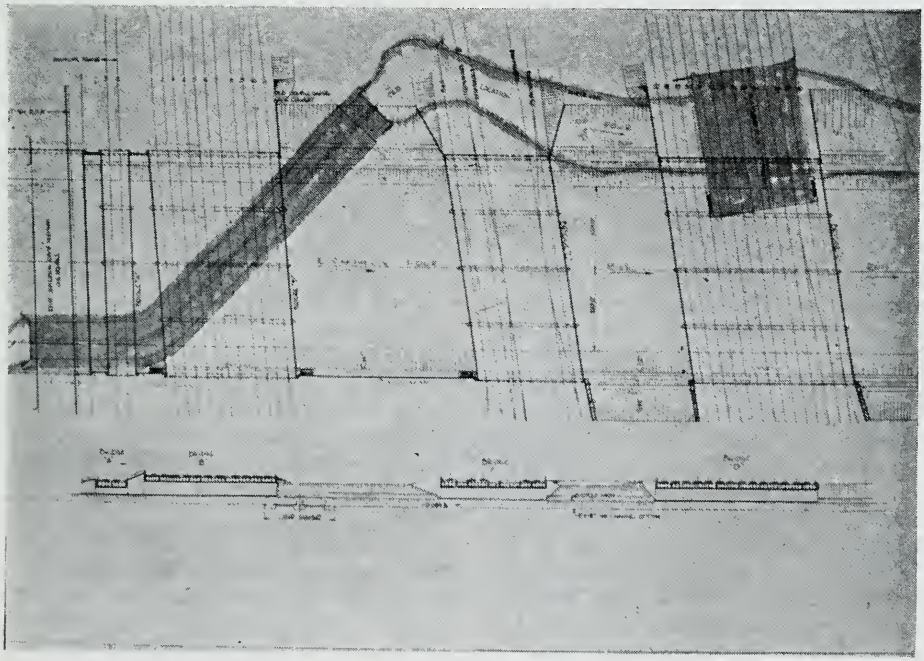
No practical way of changing the alignment of the south receiving yard tracks could be found, therefore, they, too, were detoured in groups of three to five tracks at a time while the new bridge was constructed. In addition, the new bridge was constructed slightly wider than the old structure in order that additional tracks could be placed on the bridge, thus reducing the amount of temporary track and catenary work required. The new bridge is eleven tracks wide. Just below the south receiving yard bridge, essentially in the middle of the yard, is a new nine-track structure carrying a portion of the north classification yard tracks. This structure was planned and built in an area where no tracks or bridges existed prior to construction in order that only a one-time move of the tracks was required, thus no temporary work was done to accommodate the throat of this twenty-seven-track portion of the north classification yard. Immediately below this nine-track bridge is the location of the old nine-track timber trestle carrying the exit throat of tracks thirty through fifty of the north classification yard. Alignment could not again be changed on these tracks and it was necessary to construct a seven-track temporary structure just above the old trestle and a two-track temporary trestle just below the old trestle, thus allowing the old nine-trestle to be removed and traffic maintained. The new structure at this point would ultimately be fourteen tracks wide. From this slide you can see how confined our working area was as far as width is concerned—U.S. Highway 1 at the top and the Washington subway system and the George Washington Memorial Parkway at the bottom.

Slide 7

Here is a more detailed drawing of the bridge structures themselves, the old culvert being more visible in yellow. From left to right, U.S. Highway 1, the



SLIDE 6



SLIDE 7

two main line tracks, the eleven tracks of the south receiving yard, the nine tracks in the throat of the north classification yard tracks 1-26, the fourteen-track bridge carrying the north classification tracks and the Metro system on the extreme right. At the bottom of this slide is a typical cross section of the entire yard showing the differential in elevation of the various bridges and their relative width and height.

During the design phase one of the major problems with which to reckon was that approximately three-fourths of the tracks to be reworked were electrified for, at that time, Penn Central operation. This project was estimated to cost 9 million dollars before design was begun. It turned out to be a project of approximately thirty million dollars which was in excess of the funds available to the Corps of Engineers. Therefore, it was necessary that the project be reviewed by Congress prior to final approval.

Slide 9

It was initially planned that the railroad bridge structures be of composite steel and concrete ballast deck. However, because of the escalating steel costs at that time, Congress specified that the railroad bridges in this project be pre-stressed concrete. I am not sure, but, probably, these are the only pre-stressed railroad structures in the country mandated by Congress. Of the thirty million dollar appropriation, approximately sixteen million dollars were for permanent bridges, two million for temporary structures, four million for track work and five million for electrification. This is a drawing showing a typical pre-stressed concrete box beam. The four hundred seventy-two beams in the project were very similar with minor modifications made for exterior beams and a slight variation of the end skews. All of the beams were approximately sixty-eight feet in length, six feet high and four feet wide. Wall thickness was approximately six inches. Four diaphragms were located in each beam, each diaphragm having two packing bolt holes pre-cast. In the bottom right corner you will see a detail of the shear key. The shear key was epoxy grouted after the beams were in place. Both sides and the bottom of each beam were finished. The top of each beam was unfinished in order to improve the bonding for the cast-in-place deck slab. Forty-six pre-stressing strands were in each beam, these being one-half inch in diameter stressed to two hundred seventy kips. Each beam weighed approximately fifty-two tons. Before final design was completed for the entire railroad project, it became evident that we must expedite construction, therefore, the project was broken into two contracts, Contract I being let while design was continuing. DeLeuw Cather Associates was selected to handle construction management of the project for the railroad.

Construction was started in early spring of 1975. Contract I of the project consisted of the construction of the seven-track and two-track temporary bridge structures. This work was contracted by the railroad to John Driggs and Shirley Contractors.

As the work progressed, the piles were cut off and caps installed. This was all untreated timber;

Steel stringers were then placed;

Untreated ties installed;

Steel strap guard rails and board walkways were placed;

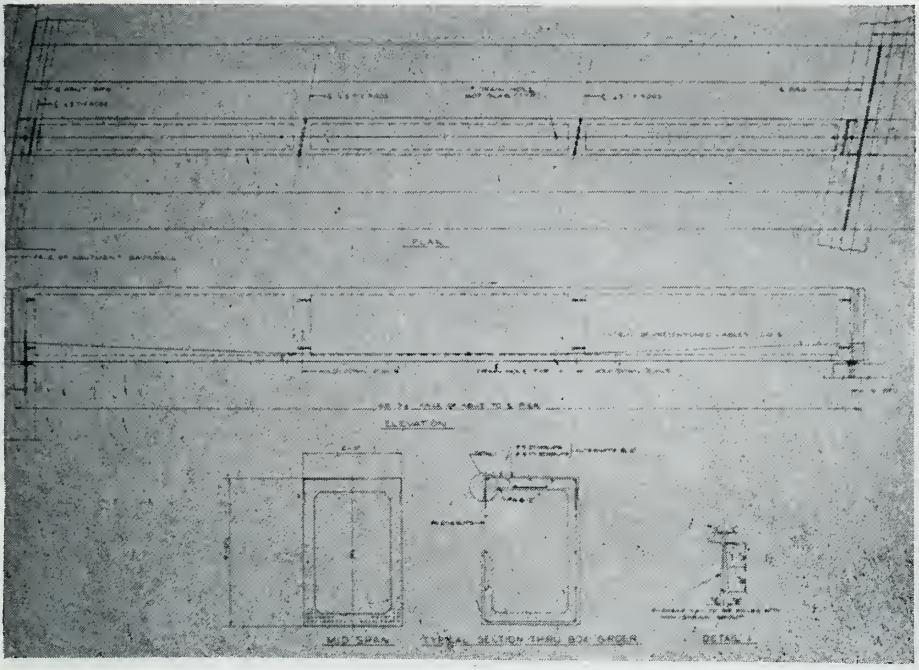
Handrails were put in place and bridge was finished;

Temporary tracks were constructed at the end of the bridge but not cut in in Contract I.

Contract II for the completion of the project was begun in January, 1976. The prime contractor was Ohio Valley Construction Company. Kasmer Electric did the electrification and Delta Railroad Construction Company did the track work.

The work was begun by tying in of the nine temporary tracks and the removal of the old nine-track timber trestle.

As soon as the old structure was out of the way, sheet piling was placed for



SLIDE 9

the piers and abutments of the new bridge.

Slide 20

Since the new channel did not necessarily follow the exact alignment of the old channel, some of the piers and abutments were constructed on dry ground. This view shows the pre-stressed concrete piling being driven. Incidentally, twenty miles of pre-stressed concrete piling were used in this project.

Footings were poured and concrete piers and abutments constructed.

Slide 22

Another view showing one completed pier and progress on the second.

While the pier and abutment work was in progress, Shockey Brothers, approximately seventy miles away from the job site, began construction of the pre-stressed concrete beams.

Interior forms with the pre-stressing strands and reinforcing cages were ready for placing of the outside form.

The form was approximately six hundred feet long in order to construct eight beams simultaneously.

The concrete was poured.

Slide 30

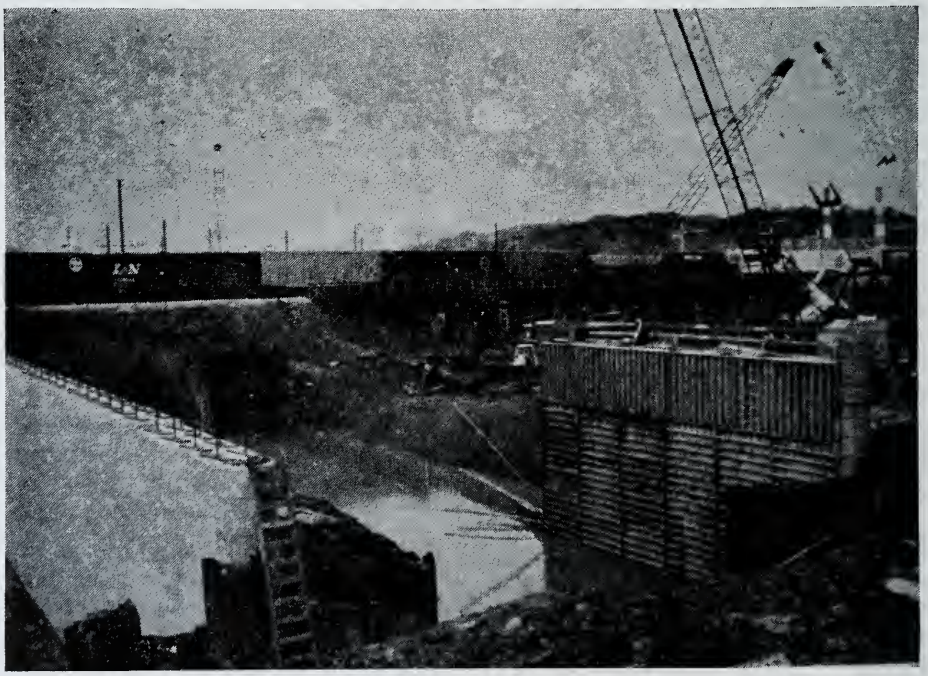
This is a view of a finished beam loaded and ready for shipment to the job site on a specially equipped TTX car.

The girders were being placed on the completed abutments and piers as construction progressed. Some of the pilings from the old wooden structure had not yet been removed.

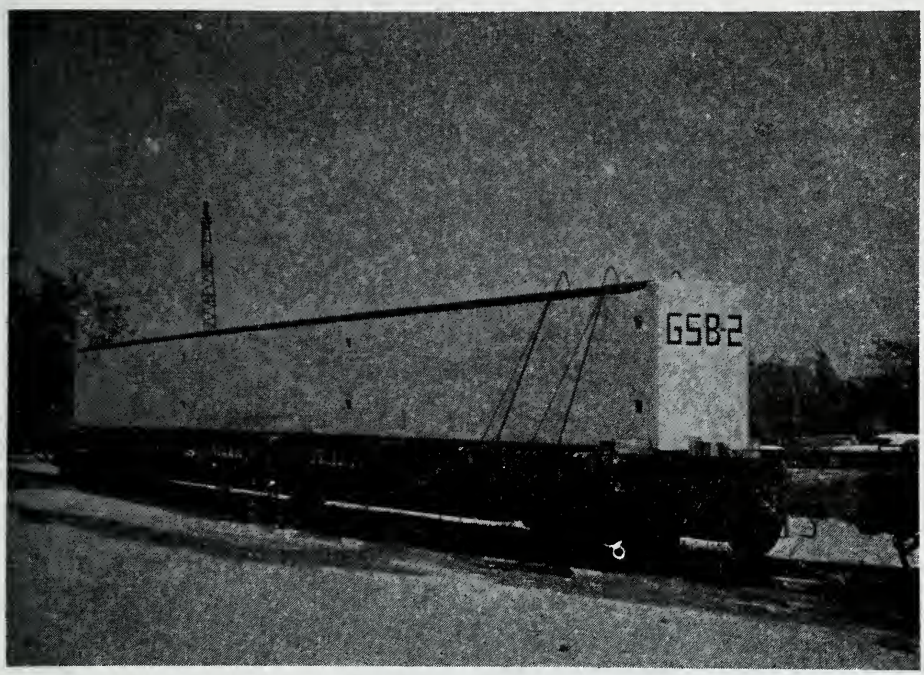
The system for placing the girders was changed and a single three hundred-ton crane was used to handle the fifty-two beams instead of two cranes.

Slide 34

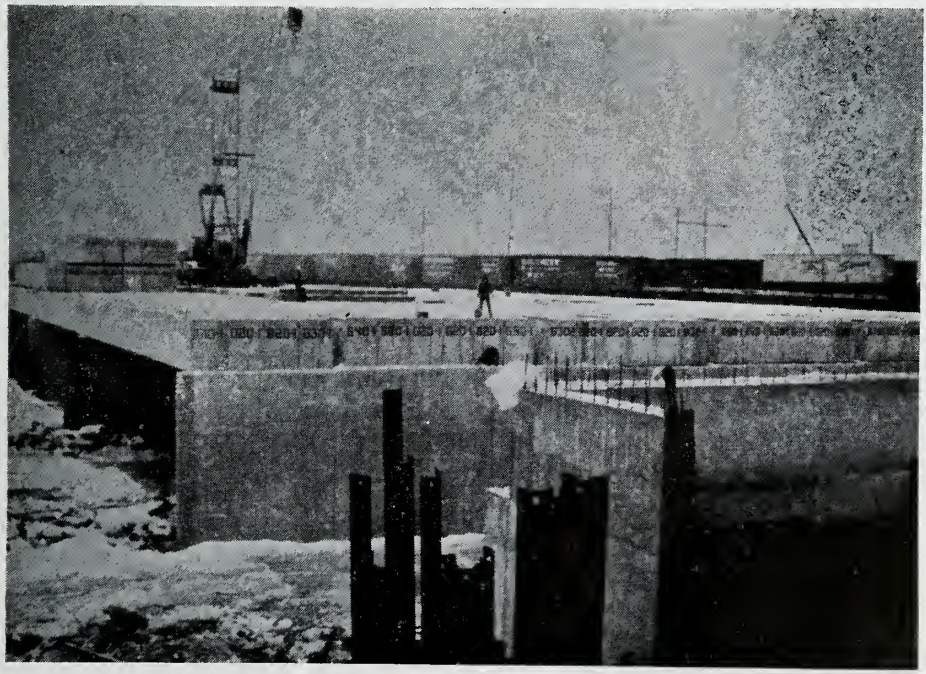
SLIDE 20



SLIDE 22



SLIDE 30



SLIDE 34

As the pier construction progressed, you can see that the box beams were being placed immediately behind the pier and abutment completion.

Cold weather and snow did not appreciably delay the project since the contractor had such a massive amount of work to do that he was able to schedule the work around the weather conditions.

Slide 37

Since we have seen much construction since my showing the drawings, here is a typical section across two tracks. You will see the girders, four under each track, the sloped concrete slabs, the waterproofing membrane, the drainage system, ballast and track.

The sloped 6-inch thick concrete slab was poured directly on top of the box girders.

The pre-stressed girders were packed in groups of either 4 beams or 8 beams with a space left between the girders at least at two track intervals. Steel plate was used to span these gaps and also a drainage pipe between the girders.

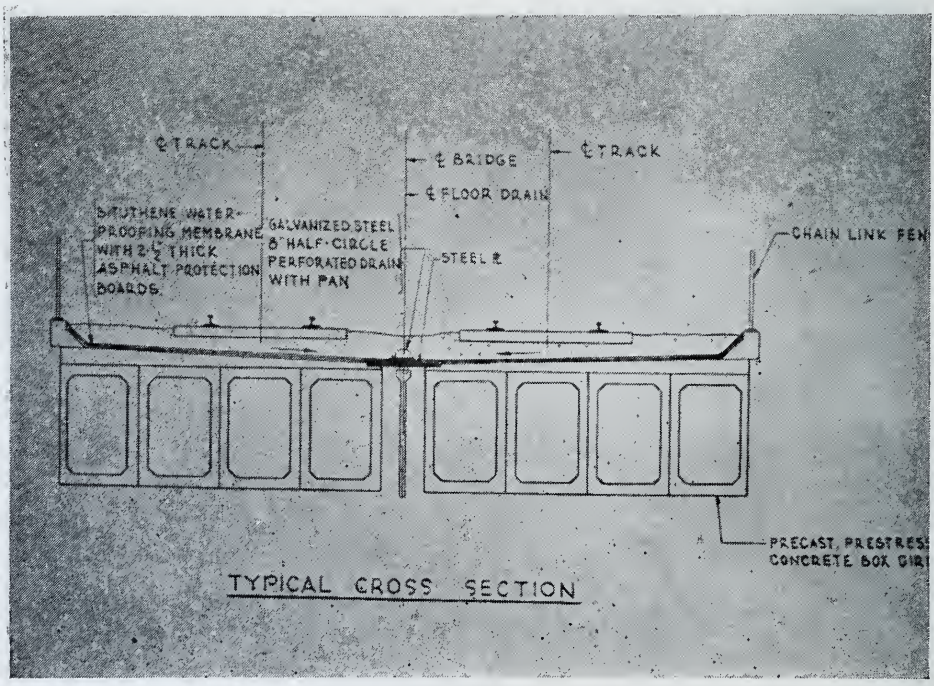
After the slabs and plates were in place, the entire surface of the bridge was covered with mastic, butyl rubber and two layers of asphalt-impregnated fiberboard to assure a waterproof deck. We have found absolutely no leaks to date.

Ballast was placed over the fiberboard and track construction on the bridges was begun. Half-round perforated corrugated drains were installed over the steel plates and waterproofing.

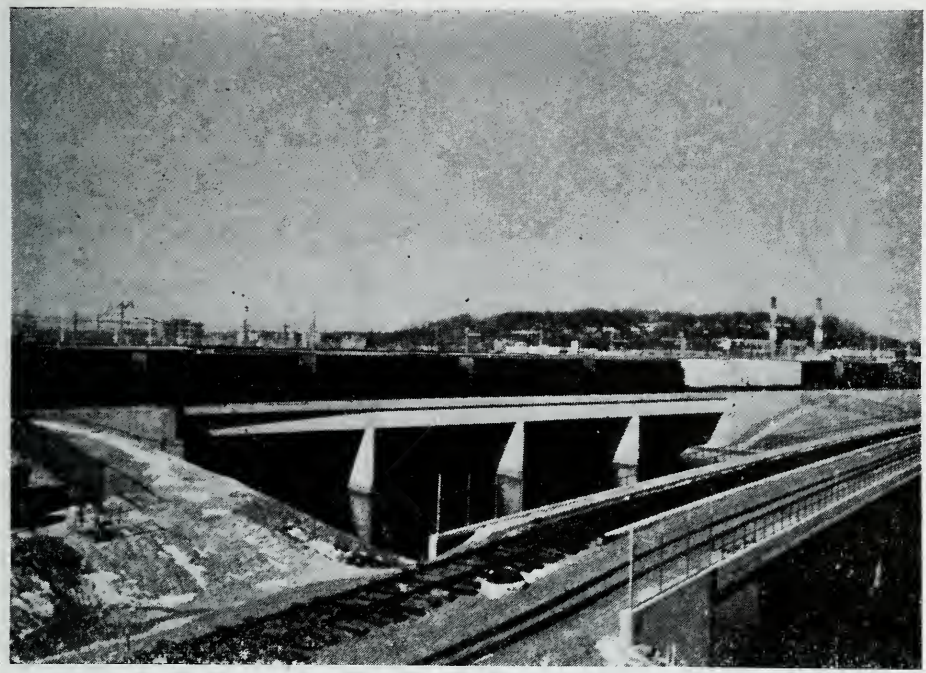
When this fourteen-track bridge was completed, the two temporary bridges were removed and channel excavation down stream begun. A steel bridge on the right was constructed by WMATA to carry the Washington subway system. Coordination of their work and ours created many challenges.

Slide 43

Here is a view of the completed four-



SLIDE 37



SLIDE 43

teen-track bridge and the essentially completed Metro structure.

At the same time construction was begun under the south receiving yard tracks, many problems were encountered because it was necessary to remove the old twin arch culvert which ran at a skew across the alignment of the piers and abutments of the new bridge.

Extensive shoring was required for construction in this area.

While the bridge work was progressing, the approaches to the bridges were being prepared. Catenary poles were erected in the open areas.

Most of the catenary structures were in place prior to track construction.

Thirteen and nine-tenths miles of track were relocated, moved or built, along with seventy-seven turnouts.

Some of the catenary structures were constructed as part of bridge pier construction.

It was necessary to maintain the catenary during construction in order to protect Conrail freight movements.

Slide 54

A view between the fourteen-track bridge and the nine-track bridge at completion of the nine-track bridge showing channel excavation. Here you can better see the method used for mounting catenary poles on the bridge.

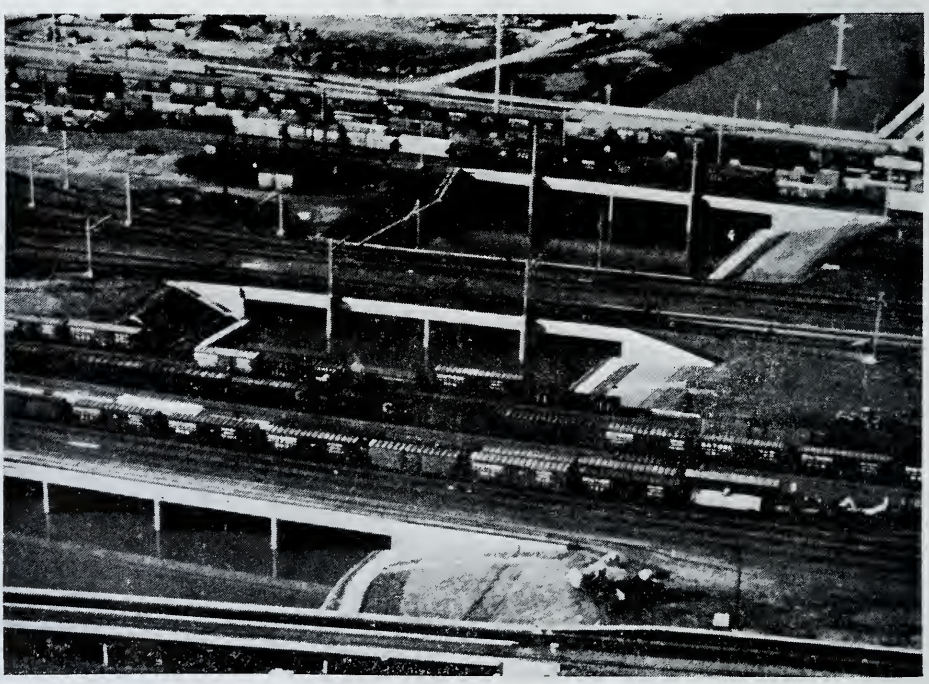
In the meantime, work was continuing on the eleven-track bridge carrying the south receiving yard. The remainder of the bridge construction was identical to what I have already shown after this difficult foundation problem was solved.

The bicycle path required an extensive amount of gabion work.

Slide 59

Aerial view of the completed project. Metro bridge at the bottom; above that our fourteen-track bridge, our nine-track bridge and our eleven-track bridge. At the extreme top of the picture is U.S. Highway 1. The bicycle path is on the right side of the channel.

SLIDE 54



SLIDE 59

Slide 60

An overall view of the project area looking north. This project was essentially completed in December of 1979 and the dedication was held last month.

President Gould: Thank you so much, Mr. Hobbs, for this interesting and informative slide program.

Mr. Williams, will you introduce our next speaker?

Mr. Williams: I would like to introduce Mr. Manfred Grove, President, Silikal North America, Inc.

SLIDE 60

High Performance Patching System to Remedy Damaged Concrete

REPORT OF STANDING COMMITTEE NO. 2

By MANFRED GROVE

President, Silikal North America, Inc.

Manfred Grove

Thank you for your interest in polymer concrete material systems, which were developed during the last twenty years in Europe, and, which have enjoyed a rapidly growing, successful track record in concrete restoration and industrial flooring application during the last fifteen years.

The multi-purpose Acrylic Reactive Resin Polymer Concrete Material (PCM) system employing Methyl Methacrylate (MMA) was introduced recently by Silikal North America, Inc. of Bridgeport, Connecticut, after years of development, testing and field success in Europe. Silikal binds tightly, is strong, and outlives the concrete structures it rehabilitates. The material was developed by Silikal and Rohm and Hass in West Germany. (Since 1970 Rohm GmbH)

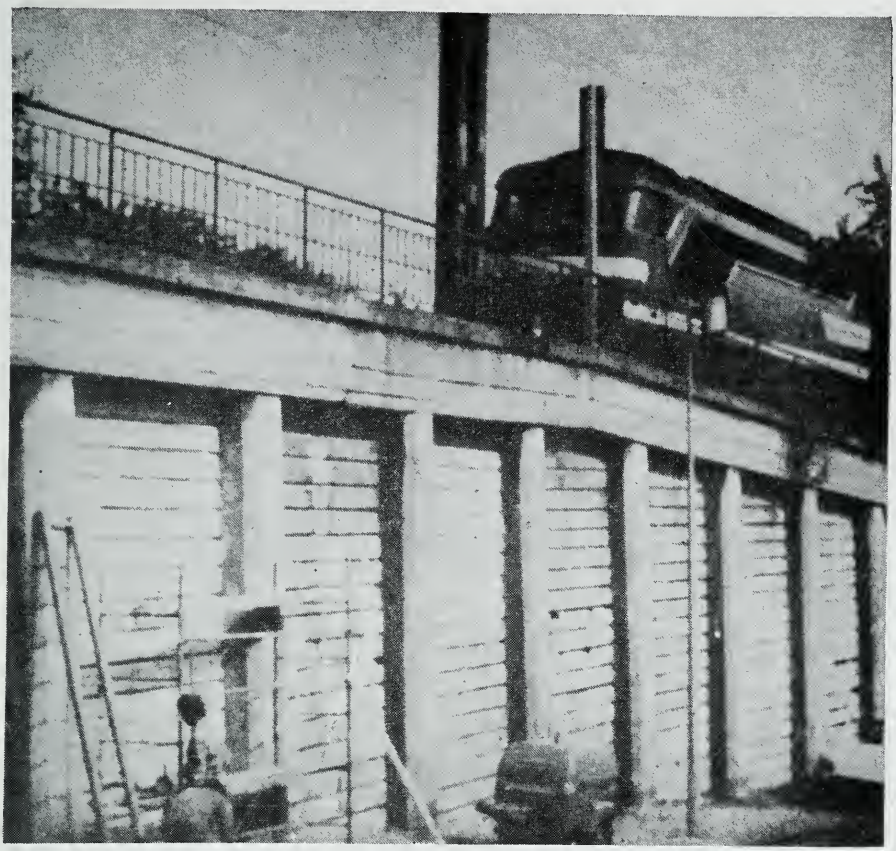
It has been used on concrete ties and inverts, deteriorated concrete in switching yards, on station platforms and bridges and used for other structure revitalization projects. In service areas it has been used on damaged conventional concrete floors, ramps, stairs, driveways and walks. In all these uses it has proved to be most effective.

Effective Where the Following Factors Are Critical

- Short down time (cure time 45 minutes to 2 hours)
- Workability in temperatures down to 14 degrees F (—10 degrees C)
- Strong bond to concrete substrate
- Monolithic intercoat adhesion, even after years of service, for easy and perfect repairs
- High resistance to heat shock, mechanical wear and chemical attack (for instance, salt, organic acids, detergents, oils, fats, etc.)
- Skid resistant, hygenic, seamless, easy to clean
- Aging and weather resistant (ultraviolet light resistance, etc.)
- Simplicity of application for unskilled personnel
- Eliminating scheduling problems due to idling work crews

Curing

The Silikal system in case after case has shown itself to be a cost effective method of restoring damaged concrete. The product can be applied in thin, self-leveling overlays or as a matrix for bonding coarse aggregate. It cures fast—from



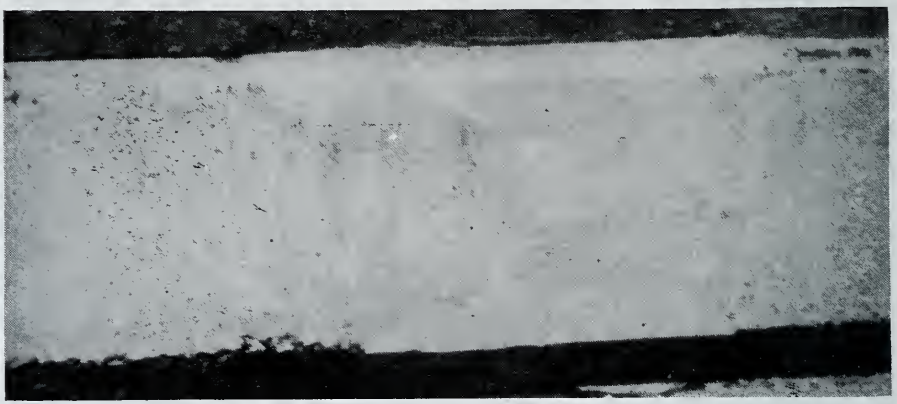
POLYMER concrete material, used to structurally rehabilitate this concrete retaining wall on a French commuter line, prevented a shut down of train operations, says a representative of Silikal North America.

one to two hours after placing—to compressive strength of 5,000 to 10,000 psi even under working conditions having atmospheric temperatures as low as 14 degrees Fahrenheit. Once cured they perform in a manner that not only increases structural strength, but provides durability. The material is impervious to deicing chemicals, resists wear, chemical action, and freeze and thaw stresses.

The fast curing results in far shorter "traffic down-time," improved safety, fewer traffic maintenance requirements, all of which are significant dollar savings. The fact that it may be used for year around application, temporary repairs are not necessary.

Types of Application

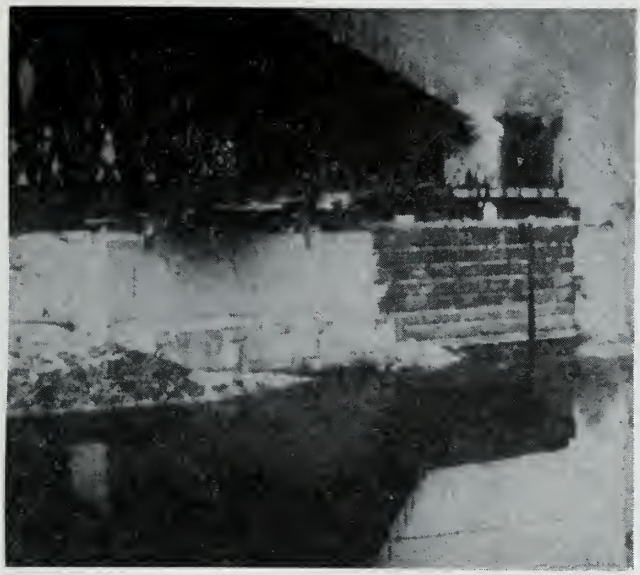
- Repairing spalled and eroded concrete
- Rebuilding joints, steps and edges in concrete structures
- Grouting bearing pads and foundations
- Rehabilitating structural concrete members
- Forming whole or partial monolithic concrete structures
- Pre-casting lightweight, high strength polymer concrete
- Providing wearing surfaces on concrete
- Coating and overlaying concrete for protection



AT TOP is shown one of the badly damaged ribs in the retaining wall. Below is the same rib after R-17 patching. It is also claimed that engineers had tried other products for the long term solution to this problem.

The polymer concrete material has been used successfully on European railroads to solve problems in bridge bearing shimming operations, high strength anchor bolt grouting and in the repair of structurally deteriorated concrete bridge members, ties and platforms.

Chemical or mechanical methods such as sandblasting, scrabbling or scarifying are used to prepare deteriorated or damaged concrete for PCM application. The pre-treatment removes debris and opens the pores in the surface of the old concrete to allow acrylic liquid primer to penetrate into and cure to make a tight bonding with the PCM patching material. Silikal offers two primers, a two-part R-41 Super for use on dry concrete and a three-part R-41 Super-i, for damp concrete. The primer may be brushed or sprayed where the patch or overlay is to be used. The primer is not intended for application under "wet" conditions but as an extra safeguard when moisture is present in the pores or fine hair cracks will prevent maximum penetration. The R-41 Super-i primer reacts and removes some moisture, but the surface should be fully dry before its use. The curing of the primer system within the surface of the concrete prevents, on the application of the R-17 patching material, absorption of liquid monomer component by the concrete. The seal so provided by the primer assures that the R-17 binding liquid will remain in and cure within its



RAILROAD bridge structure is moved to a new abutment in which PCM was used as bearing-pad shim material. During the work R-17 was installed in temperatures as low as 15 deg. F.

applied polymer concrete matrix. They cure together to produce a "welded" monolithic overlay from within the primed concrete substrate up to the polymer concrete surface.

Areas of Application

- Any type of concrete slab, column, beam, etc.
- Stair cases
- Dams, tunnels, and piers
- Railroad beds, switching yards and platforms
- Industrial machinery beds (bearing pads)
- Bridge bearing pads
- Sidewalks and driveways
- Ramps and loading docks
- Heavy duty industrial floors
- Seamless decorative (decorative and hygienic)
- Pre-cast polymer concrete parts

Whether used as a patch, overlay or coating Silikal PC exhibits an unusually high level of permanence and strength. It provides an excellent bond with existing concrete.

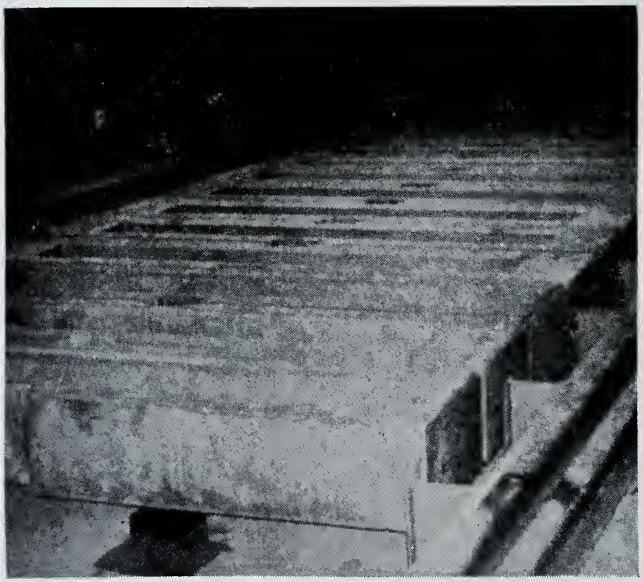
Silikal PC exhibits wear resistance up to three times that of normal high quality concrete installations. It is impervious to water and chemicals.

Without question, even though the basic materials of Silikal PC cost more, the superior physical characteristics contribute greatly to the cost effective value of this material. These superior physical characteristics include the permanence and strength, the ease of use and speed of curing, the effective reduction of labor and time costs, the elimination of any need for repeated maintenance, and the reduced down time.

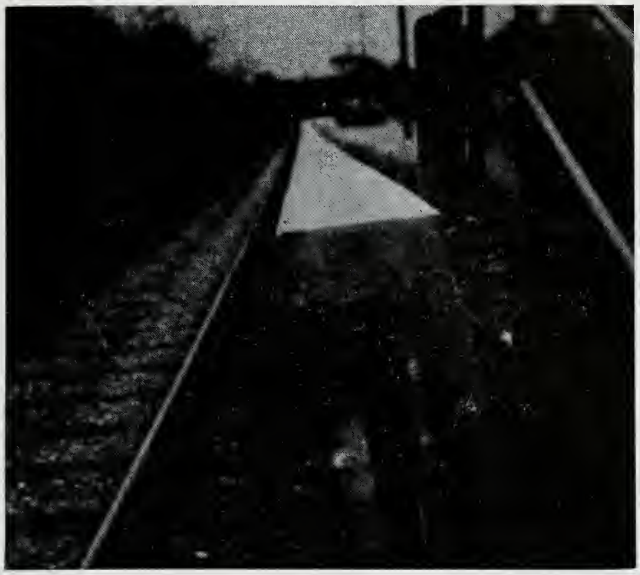
How to Use R-17 Trial Size Materials Package

Silikal, North America, Inc., has a $300 trial package Silikal multi-purpose polymer concrete they offer to be tried which contains 305 pounds of the R-17 mortar and two quarts of primer and

NON-SHRINK capability of the material was also used in shimming individual ties and for setting anchor bolts for tie brackets on a commuter bridge.



NEOPRENE cushions within a subway tunnel in Frankfurt, Germany, are supported atop PCM grout pads. The precast concrete slabs shown contain hollows for final insertion of concrete ties.



PLATFORM edging, rehabilitated by the "all purpose" R-17 is shown. In addition, select PCM's can be used for overlaying or patching to skid-resistant walkways, stairs and other surfaces.

offer the following instructions for its use.

Substrate Preparation

Substrate must be cleaned of all loose materials, oils, greases, rubber marks, asphalt and other foreign substances. Concrete should be as dry as possible, at least surface dry.

R-41S Primer

For good bond, apply a thin layer (do not leave puddles) of R-41S primer with a brush. Add 5% to 8% by volume of R-41S hardener powder to the liquid in the container and mix for 10 to 20 seconds so that the powder is dissolved. Primer pot life is 10-15 minutes and it will harden in 30-60 minutes. Apply the primer immediately after the powder is dissolved. As a general rule-of-thumb, for sound, good quality concrete, use ½ gallon of primer to cover 75 to 80 sq. ft. For highly porous concrete, use ½ gallon of primer to cover 35 to 40 sq. ft.

R-17 Powder and Liquid

Pour powder component into the supplied plastic mixing bag. Add approximately ½ gallon of liquid component to each 30 lb. bag of powder. Firmly twist bag opening shut with 360° turn so that air escapes and only a small space is left above the mix. Hold bag closed in this position, roll bag on ground, lift corners of bag so that powder moves to center and rotate bag vigorously for about 15 seconds to thoroughly mix. If desired, aggregate, such as round, dry (pea) gravel up to 1¼" can be added, up to 150% by weight, directly to the plastic mixing bag. If aggregate is added, maximum size is to be no larger than 1/3-1/2 the depth of the hole to be patched and minimum size is to be *no smaller than No. 10 sieve*. Mix again to thoroughly wet all aggregate.

To apply, slit a corner of the plastic

Silikal™

SILIKAL NORTH AMERICA, INC.

PHYSICAL PROPERTIES OF SILIKAL R7 OVERLAY & R17 PATCHING SYSTEM

PHYSICAL PROPERTIES **R7**	VALUE	UNIT	TEST SPECIFICATIONS
Compressive Strength	11,000.00	psi	ASTM C109
Flexural Strength	3,400.00	psi	ASTM C348
Tensile Strength	2,100.00	psi	DIN 53455
Impact Strength	0.60	cmkp/qcm	DIN 53453
Elongation at Rupture	0.10	%	DIN 53455
E-Module	2,560,000.00	psi	DIN 53457
Ball Indentation Hardness 10 sec.	75,800.00	psi	DIN 53456
Volume Resistance	7.5×10^{13}	Ohm x cm	DIN 53482
Surface Resistance	7.0×10^{12}	Ohm	DIN 53482
Thermal Expansion (32-122°F)	2.5×10^{-5}	1/°C	VDE 0304
Water Vapor Permeability	1.6×10^{-8}	g/cm/h/Torr	DIN 53122
Water Absorption after 4 days	1/2	grains	DIN 53472
Wear Resistance	3/64 - 5/64	inch	NBN 748-19

PHYSICAL PROPERTIES **R17**	VALUE	UNIT	TEST SPECIFICATIONS
Compressive Strength	8,000.00	psi	ASTM C109
Flexural Strength	2,400.00	psi	ASTM C348
Tensile Strength	1,100.00	psi	DIN 53455
Impact Strength	0.60	cmkp/qcm	DIN 53453
Elongation at Rupture	0.56	%	DIN 53455
E-Module	967,000.00	psi	DIN 53457
Ball Indentation Hardness 10 sec.	22,900.00	psi	DIN 53456
Volume Resistance	7.5×10^{13}	Ohm x cm	DIN 53482
Surface Resistance	6.5×10^{12}	Ohm	DIN 53482
Thermal Expansion (32°-122°F)	3.3×10^{-5}	1/°C	VDE 0304
Water Vapor Permeability	1.3×10^{-8}	g/cm/h/Torr	DIN 53122
Water Absorption after 4 days	1	grains	DIN 53472
Water Resistance	9/64	inch	NBN 748-19

YIELD OF SILIKAL Components **R17**	APPLICATION THICKNESS 1/2" or under lbs.	ft.³	min. 5/8" lbs.	ft.³	min. 1-1/4" lbs.	ft.³	min. 2-1/2" lbs.	ft.³
Powder Component	30.0	0.20	30.0	0.20	30.0	0.20	30.0	0.20
Liquid Component (1/2 gal.)	3.7	.05	3.7	0.05	3.7	0.05	3.7	0.05
add								
Coarse sand* Sieve #10-5/16"			16.0	0.10	6.0	0.04	9.6	0.06
or 5/16" - 5/8"			-	-	24.0	0.15	12.8	0.08
(Pea) gravel* 5/8" - 1-1/4"			-	-	-	-	16.0	0.10
TOTAL	33.7	0.25	49.7	0.35	63.7	0.44	72.1	0.49

* Residual moisture should not exceed 0.5%, for maximum strength.

bag with a trowel, tilt and allow to flow out.

As with conventional concrete, distribute material and finish surface with a screed or trowel. Feathered edges can be drawn by using a paint brush that has been moistened with the liquid component. For larger applications the mortar may also be prepared in mortar mixers.

Cleaning

Clean all tools with R-17 liquid component which should be kept and re-

used to make additional mortar within two or three hours.

Precautions

R-41S Primer and R-17 Liquid components are flammable and should be handled like gasoline. Once placed it will, however, not support combustion. Direct contact with Silikal products may produce minor skin irritation to persons prone to such reaction. As a preventative, gloves, goggles, and a protective clothing should be worn by people using the material.

Limitations

Do not use Silikal R-17 below 14°F nor above 100°F substrate temperature. Do not use on asphalt and please remember, the concrete surface and the aggregate *must be dry!*

Shelf Life

PCM-based materials have a guaranteed shelf life of six months. Shelf life depends on the storage temperature and on how the purchaser maintains the integrity of the packaging system. Successful shelf life of the liquid component materials, with proper storage, may be as long as eight years. The potency of the powder component is relatively easy to restore.

During the last two years Silikal has introduced a number of polymer concrete products. A few U.S. companies have attempted to copy some of these products which have not been as successful. The company asks you to feel free to call to discuss concrete restoration and industrial flooring/coating problems. We will also give you up-dated information on polymer concrete material systems and their applications.

Mr. President, Members and Guests

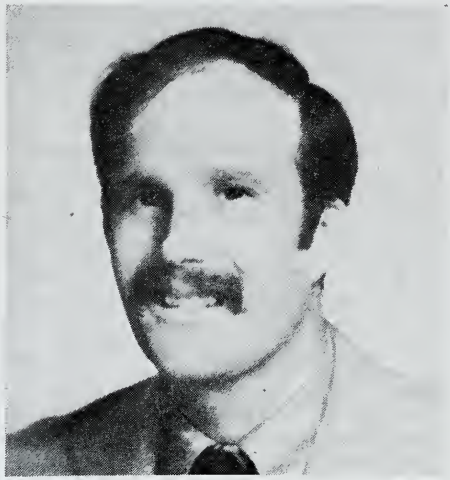
For the final Special Feature of the 1980 ARB&BA the following report on "Coatings" will be given by Ken Tator of KTA—Tator Inc. Mr. Tator is president of KTA—Tator Associates Inc. of Coraopolis, Pa., near Pittsburgh. The firm is a consulting engineering firm specializing in paints and protective coatings. KTA—Tator Associates has approximately 29 employees, and provides consulting, coating inspection, instrument sales, testing evaluation and analytical laboratory services to a variety of clients in industry, nuclear, government and marine industries.

Ken has a B.S. in Chemical Engineering from Lafayette College, and an M.B.A. from Columbia University. He is a Licensed Professional Engineer, Corrosion Specialty. He is a member of National Association of Corrosion Engineers, The Steel Structures Painting Council and is active on several committees. Mr. Tator.

Coatings

By KEN TATOR

KTA - Tator Associates



Ken Tator

Apply Knowledge When Applying Paints

Paint application is the oldest and most widespread method of achieving a protective and, usually, decorative finish for industry. The range of substrates to which paints are applied is vast, encompassing metals, plaster, cement and concrete. Furthermore, an often confusing diversity of paints and coatings are available to users and there are a variety of different application methods.

A proper selection program will do much to eliminate the confusion associated with choosing the "right" paints. Substantial benefits can result from:

1. Proper paint selection through testing.
2. Specifying and purchasing paint on a percent solids basis.
3. Cleaning and priming the surface prior to erection.
4. Inspection and preventive maintenance.

Proper Paint Selection Through Testing

One paint may perform better than others in one application, worse in other exposures. Laboratory testing, conducted by paint manufacturers, may not identify these differences. It is desirable to set up a field test program.

Reputable manufacturers can be requested to give their recommendations, or a consultant asked to specify test paints; one or more exposure sites can be selected; and the painted test panels exposed. The performance of the panels is regularly reviewed using a standard procedure. New samples are added over a period of time, so that the better paints can be identified and written into future painting specificiations.

Specifying and Purchasing Paints On a Percent Solids Basis

The protective ability of a paint coating is generally a direct function of its thickness, and the cost of a coating system is generally a function of the number of coats required to give the necessary thickness. Thus it is essential that paint costs be considered on the basis of mils per square foot and the corresponding percent of solids incorporated in the paint. The cheapest paints in terms of dollars per gallon are often the most expensive in terms of dollars per mil per square foot applied.

Cleaning and Priming the Surface Prior to Erection

Approximately one-third of the costs of surface preparation and priming steel

structures can be saved by doing this prior to erection, either in a shop or at the jobsite. Touch-up priming and finish coatings can then be applied after erection.

In some cases, additional savings can be realized by applying the entire three-coat system in a paint shop, with field touch-up after erection.

Inspection and Preventative Maintenance

It is essential to assure that the surface preparation has been thorough, that the coating thickness is to the specified minimum, that the painting is not done under adverse moisture conditions, that proper equipment is used and so forth.

It is not enough to have an engineer "look it over." Painters tend to cover their surface preparation mistakes; and without proper instrumentation it is impossible to tell whether the coating has for example, 3 mils thickness or 15 mils. (See Coating Instruments, Appendix I)

Periodic inspection of painted surfaces for areas that are just beginning to rust and show failure, and the touch-up painting of these areas can prolong the life of a protective paint system for 12-15 years or more.

The Performance and Formulation Requirements of A Paint System Are Dependent on Both the Substrate and Its Intended Interaction with the Environmental Surroundings

Table I lists the various types of industrial paint and their characteristics. (See Appendix II)

Despite the Various Types of Paints and Their Applications, All Paints Are Basically the Same

All paints contain a liquid polymeric or resinous material known as a binder. It is this component which, after conversion to a solid through the paint's drying process, provides the surface film with adhesion, flexibility, toughness and durability.

Paints also contain finely dispersed solid materials called pigments. A major function of a pigment is to provide color and opacity for the paint film. Certain types of pigment improve film durability and provide corrosion resistance for metal substrates. In addition, other components are usually incorporated into paints to modify their basic characteristics. Typical additives are extenders, driers and fungicides. Solvents are also included in order to control the application process and to modify the drying characteristics.

Paints may be classified on the basis of the type of pigment, by the resin binder, or by its service application (e.g., resistant to moisture). A much more basic paint classification system is listed in Table II, this system categorizes paints solely on their physical function. After all, the object of painting is to interpose a film between the substrate and its environment. This is normally achieved by the application of a paint system comprising a number of coats of paint, each one formulated to import certain characteristics to the overall system.

How Coatings Protect

Corrosion-resistant coatings protect in almost all cases by a combination of two mechanisms: (1) by acting as a physical barrier to exclude the environment, and (2) by containing reactive materials (usually pigments) that solubilize or react in a manner that inhibits corrosion, or slows the binder aging characteristics. A classic example of a barrier protection would be a clear shellac or varnish coating, and a good example of the reactive type coating would be the sacrificial zinc-rich primers, or coatings containing chromate pigments.

Why Coatings Fail

Coatings fail for a number of reasons. Generally, however, the reasons for failure can be categorized as environmental

(Continued on page 146)

APPENDIX I — INSPECTION INSTRUMENTS

WET FILM THICKNESS

WET FILM GAGES
Estimate Dry Film Thickness Before Coating Dries.

NORDSON — 790 — Feature: Quick, accurate.

Description: Measures all types of wet coatings on flat or curved smooth surfaces. The gage is placed squarely and firmly on the surface immediately after paint application, withdrawn and the coating thickness is read directly from the wetted gage face. Two models available: 0–20 mils; 4–60 mils. Gage supplied complete with vinyl case.

CALIBRATION STANDARDS

For Use in Calibrating Magnetic Gages.

U.S. NATIONAL BUREAU OF STANDARDS CERTIFIED THICKNESS CALIBRATION STANDARDS — Description: Each card set consists of four precision plates for calibrating magnetic pull-off dry film thickness gages. The N.B.S. certified thickness is within plus or minus 5% of true thickness. Three thickness card sets available covering ranges from 1-1/2 to 80 mils. A "must" for nuclear QA.

PLASTIC SHIMS — Features: Convenient size, 1 1/2" x 2-1/2", special sizes can be cut to order, thicknesses are color coded for easy identification.

Description: Plastic thickness shims are used to calibrate magnetic pull-off and fixed probe dry film thickness gages. Thickness shims are available individually or in sets. Shims available range from 1 to 60 mils. Shims come complete with plastic carrying pouch.

SH – LOW 6 shims 1–10 mils

SH – HIGH 7 shims 15–60 mils

SSPC MAGNETIC GAGE STANDARD — Steel Structures Painting Council Method SSPC PA 2 describes in detail calibration and measurement techniques for all magnetic gages. This standard should be owned by everyone who uses a magnetic gage.

DRY FILM THICKNESS GAUGES

MIKROTEST — 102 — Features: Light weight, 2 1/4" x 1" x 8-1/2", non destructive, one point measuring, logrithmic dial indicator, balanced mechanism measures in any position. Available in four range models from 0 to 400 mils (0–6, 1/2–40, 20–200, 100–400).

Description: This instrument is suitable for measuring the thickness of dry non magnetic coatings when applied over a steel or ferrous base. Film thickness measured is read directly from the scale in mils (.001"). Complete with carrying case and wrist strap. A calibration tool for adjusting the instrument is also available.

MIKROTEST Ni — Similar to Mikrotest, easy to operate hand gage for measuring nickel coatings on ferrous or non ferrous materials. Available in two ranges from 0 to 4 mils.

MIKROTEST II — Features: Accurate light weight, portable, non-destructive thickness instrument. Can be used on cylindrical parts. Automatic hold facility eliminates turning scale beyond actual thickness. Scales available. 0–4 and 0–40 mils.

Description: Based on the magnetic pull off principle for non-destructive measurements of non magnetic films applied to a ferrous base. Complete with vinyl covered steel carrying case and one calibration standard. Optional Wet Film Thickness Gage available. 0–32 mils.

MIKROTEST III — Identical to Mikrotest II without hold facility. Scales available: 0–4, 0–40, and 8–120 mils; .1–4 inch.

ELCOMETER INSPECTOR — 111 — Features: Non-destructive, measures at any angle or position, light weight, one point measuring, portable — only 8 1/2 ozs. pocket size 2" x 3-1/4" x 9", rugged die cast aluminum case. Available in nine scale ranges, varying from 0 to 250 mils.

Description: Measures dry film thickness of any non-magnetic material on a ferrous base. The film thickness measured is read directly in mils or microns from the calibrated scale. Can be field calibrated with a simple screw driver adjustment. Complete with leather carrying case, wrist strap, non precision shims and instructions.

ELCOMETER PULL OFF — 157 — Features: Simple to operate. The instrument body made from drawn anodized aluminum triangular sections; extremely robust, three scales on instrument: metric, imperial and arbitrary. Size 5 3/4" long. Weight 1-1/4 ozs.

Description: The gage is suitable for use on non-magnetic coatings applied over a ferrous base. The magnet in the gage is placed on the coating, and the body is slowly raised. The point at which the magnetic contact breaks indicates the thickness of the coating. Measurement range is 0 to 600 microns, 0 to 25 thous., and 0 to 10 linear arbitrary scale (50 divisions). Supplied with leather case, arbitrary scale card and shims.

ELCOMETER CHEMIGAGE — 107 — Features: Inexpensive, quick, rugged, pocket size, non-destructive. Indicates in any position up to 1/8" thick.

Description: Chemigage gives a quick "go—no go" indication of a required thickness on any non-magnetic material applied over a ferrous base. It consists of a permanent magnet housed in a knurled aluminum case. Simply calibrate the gage on a shim of required thickness, when applied to a surface the magnet will stay down if the coating is less than that required. Supplied with thickness standards and instructions.

ELCOMETER 101/1 — Features: High accuracy, rugged die cast aluminum case, non-destructive, pocket size 3 1/2" x 2" x 1", lightweight only 6 ozs.

Description: For measuring dry film thickness of any non-magnetic material on a ferrous base. Utilizes a permanent magnet and two point contact principle. Thickness readings can be read directly from the calibrated scale in thousandths of an inch or microns. Dual English and metric scales are available in measurement from 0 to 3/4". Supplied complete with non-precision color coated calibrations shims and leather case.

VERIMETER — ML-301 — Features: Portable (8" x 6" x 2-1/2") battery operated dry film thickness instrument for accurate non-destructive measurements. Solid state circuitry housed in rugged aluminum body.

Description: Based on the electro magnetic principle for accurate thickness determinations of non-magnetic films applied to ferrous substrates. Thicknesses up to 50 mils precisely indicated on 2 inch meter. Instrument complete with plastic calibration shims, batteries, instructions, and suede carrying case. Unique optional accessory is a thickness monitor unit that sounds when thicknesses below a preset minimum are encountered. Optional unit also includes jack for attachment to laboratory strip chart recorder.

MINITECTOR — 150 — Features: Portable (9-1/2" x 6 1/4" x 2-1/2") battery operated instrument utilizing either electromagnetic, eddy current, or both principles in the same unit for quick, accurate, non-destructive dry film thickness measurements.

Description: The (F) model can accurately measure dry film thickness of non-magnetic films over a ferrous (steel) substrate. The (N) model is for non-magnetic films over a non-ferrous metal substrate (aluminum, copper, brass, etc.). The (FN) model combines the principles of both. Scale ranges up to 75 mils on ferrous substrates and 100 mils on non-ferrous metal substrates. Instrument supplied complete with batteries, calibration shims, instructions, and leather carrying case.

MINITECTOR 158/MK III — Looks like and operates on the same principle as Model 150 above. Measures dry film non magnetic material on a ferrous base only. Ranges 0–150 and 100–400 mils.

MINITECTOR MINOR — 190 — Features: Compact (1/2" x 3-1/4" x 3-1/2") pocket sized battery operated instrument for non-destructive thickness measurements.

Description: Measures intensity and variations of magnetic flux. The instrument can determine the thickness of non-magnetic films (up to 25 mils) applied to a ferrous base.

MINITEST — Features: Battery operated self aligning single point probe, fully transistorized, automatic power switch off.

Description: Measures non magnetic coatings on steel, non-conductive coatings on non ferrous metals; and non ferrous metals on non-conductive materials. Five different models available depending upon measuring requirements.

APPENDIX I — INSPECTION INSTRUMENTS

DESTRUCTIVE DRY FILM THICKNESS

Measures Thickness on All Substrates (50X illuminated microscope).

TOOKE GAGE — MARK II — 100/TG — Features: Unique optical thickness measurement of each coat of multi-coat system on all surfaces. Not subject to magnet variations.

Description: The Tooke gage accurately measures coatings up to 50 mils thick on any substrate. Measures thickness of individual coats in multi-coat systems, provided each coat is a different color. Observation of coating cross section through an integral 50-power microscope shows intercoat contamination, entrapped air, voids, underlying rust or mill scale, pinholes, poorly adherent coats, coating embrittlement, etc. Trouble shoot causes of coating system failure. A needed supplement to the magnetic thickness gages. Complete with three cutting tips, cutting tip holder, batteries, spare bulb, leather carrying case and instructions.

TOOKE GAGE — MARK III — 103/TG — Features: Portable, battery operated dry film thickness instrument for use on coatings up to 50 mils over any substrate. New cylindrical design of the Mark II Tooke Gage with improved illumination and all cutting tips mounted on the unit.

Description: The Mark III Tooke Gage works on the same principle as the Mark II Tooke Gage. An incision made through the coating (the width of a pencil line) with one of the supplied cutting tips is viewed through the 50X microscope. Individual coating thicknesses can be determined with a precision from ½ .025 mils to ½ 25 mils. The complete instrument includes a 50X illuminated microscope, three cutting tips, batteries, carrying case, and instructions.

HOLIDAY DETECTION

HOLIDAY DETECTORS

Detects Voids or Discontinuities of Non-Conductive Coatings on Metallic Surfaces.

K D BIRD DOG — Features: Complete solid state transistorized circuitry, non-destructive, no spark hazard, low voltage, (only 30 volts applied to the coating), wired for ear phones in high noise areas and weighs two pounds, battery operated.

Description: K D Bird Dog clicks slowly on a good coating and rapidly at defects. Speed up of signal indicates moisture permeable areas. Complete with tough plastic carrying case, 50 feet ground wire and 22-1/2 volt battery.

MISCELLANEOUS

ADHESION TESTER — 106 — Features: The Elcometer adhesion tester is made of aluminum with stainless steel insert claws. Size 5 1/2", weight 2-1/2 lbs.

Description: The instrument is designed to measure the tensile strength of adhesion of applied coatings to the substrate beneath. An aluminum dolly is cemented to the surface of the coating. The claw of the adhesion tester is placed under the dolly head and the wheel on the top of the tester is tightened until the test poundage is reached, or the dolly pulls off. The breaking poundage is indicated on the scale. Four scale ranges available from 0 - 4,000 lbs. The instrument is supplied with 20 dollies, tube of adhesive epoxy, case, magnet clamp and instruction manual.

MOISTURE DETECTORS

Determines Moisture in Wood, Plaster, Concrete.

DELMHORST — BD-7 — Features: Dimensions 6 1/2" x 2 3/4" x 1 1/4", weight 1 lb. 4 ozs. Battery operated; color coded scale ranges.

Description: A precision instrument which tells when the moisture content of many surfaces is too high for safe application of adhesives or paint. The two contact pins of the electrode are driven into the surface and the moisture content is read directly from the meter. Two models available. Complete with leather carrying case and electrode.

TINKER-RASOR — M1 — Features: Completely solid state transistorized circuitry, battery operated, non destructive, no spark hazard, 67-1/2 volts applied to the coating, small enough to be worn on your belt.

Description: Gives loud ringing sound on coating defects, voids or moisture permeable areas. Provided with 15 feet of ground wire, sponge and 18" phenolic wand with six foot extension cable, and batteries.

TINKER RASOR — M1/AC — Features: Operated from 110/120 volt, 50/60 cycle a.c. line. Voltage regulated solid state circuitry. Low voltage, 67 1/2 volts applied to the coating, no spark hazards.

Description: Works on same principle as the Model M1. Can be adjusted for various sensitivities to moisture permeable or void areas in coating. Complete with 15 foot ground wire and 18 inch phenolic wand and sponge.

SURFASCOPE — SF — Features: Portable (5-1/4" x 6 3/4" x 8 3/4"), quick, accurate method for determining surface cleanliness.

Description: Quickly determine cleanliness of aluminum or aluminum alloy surfaces. Based on converting the droplet diameter of a known volume of water into a surface energy value closely related to cleanliness. Instrument comes complete including 20X illuminated microscope, pH indicator, distilled water, sling psychrometer, micro-liter syringe, instructions and an experimentally designed curve for surface energy conversions.

ZAHN VISCOMETER (Computer Calibrated) — Feature: Portable, accurate, light weight, fast "on the job" readings.

Description: This instrument is used throughout the industry to accurately measure the viscosity of coating materials prior to application. The Zahn cup is a fully machined instrument made from hard, durable stainless steel, which will withstand strong solvents. Long, looped handle and holding ring. Five orifice sizes available.

ILLUMINATED INSPECTION MICROSCOPE — FF393E — Features: Pocket sized, light weight, durable illuminated 30X microscope. Smooth focus adjustment. Powered by two "AA" batteries.

Description: One tube contains the batteries, the other a precision 30X microscope. The light is activated by simply folding the instrument body. Ideal for examination of pin holes, blisters, rust, mill scale, contamination, etc.

ELCOMETER D.C. HOLIDAY DETECTOR — 105 — Features: Weighs 12 lbs., all silicone solid-state circuitry with electronic regulation.

Description: High voltage holiday detector used to find faults in thick coatings (20 plus mils). Equipped for a.c. line operation. Battery power supply for portable in-field operation available.

Variable D.C. voltage control (0 - 10 KV and 0 - 20 KV) with a meter monitoring switch, and alarm control. Supplied complete with batteries, brush probe, case and instructions.

FERRITE GAGES

111/2F (INSPECTOR FERRITE GAGE — (Looks like Inspector dry film gage) — Description: Provides direct reading. (0 - 30 FN Number) of ferrite content in stainless steel.

FERRITECTOR GAGE — 158/F1 — (Looks like Minitector dry film gage) — Description: An electronic instrument with a constant pressure probe; double range scale (0 - 10% and 10 - 25% ferrite content in stainless steel).

FERRITE GAGE 101/32 — (Looks like Elcometer 101/1 dry film gage) — Description: Measures the ferrite content (4% - 29%) in stainless steel.

COATING CALCULATOR — 390

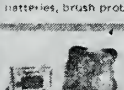
Description: The coating calculator uses three parameters: (1) Average surface roughness in mils; (2) Dry film thickness desired, and (3) Percent solids by volume of the paint used to find the paint quantity needed for a job, the spreading rate in square yards per gallon and the wet film thickness to apply. It is made from high grade acrylic materials and comes in a plastic case.

KTA TEST PANELS

Features: 3/16" x 4" x 6" with 1" channel. Standard panel made of AISI M1020 copper free hot rolled carbon steel. Mill test report available.

Description: Well known, widely used, standard KTA paint test panel incorporates common surface irregularities such as welds, crevices, round and sharp edges, pits, spatter pockets.

TEST RACKS — Galvanized and coated steel test racks capable of holding twenty four 4" x 6" test panels. Rack size 29" x 31"; all test panels insulated from rack and from each other.



SPY HIGH VOLTAGE HOLIDAY DETECTOR — Features: Portable unit for holiday testing at outputs up to 22,000 volts. Rechargeable, battery operated. Various electrodes available.

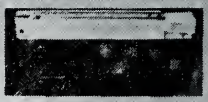
Description: Shoulder mounted unit for rapid high voltage holiday testing. Six distinct "lock in" voltage settings on each model. Holidays detected visually through sparks or by audible indicator. Instrument complete with rechargeable battery, battery charger, electrode, electrode handle, ground wire and instructions in a heavy duty wooden carrying case. Units also available for rent.

APPENDIX I — INSPECTION INSTRUMENTS

AMBIENT CONDITIONS

SLING PSYCHROMETER — Mercury — 1325 — Features: Portable, pocket size, vinyl case, attaches easily to belt.
Description: Psychrometers are used for the determination of dewpoint, temperature and relative humidity. This psychrometer has replaceable 5" mercury thermometers that range from 20° to 120°F. in one degree divisions. Supplied complete with water vial, humidity chart, two thermometers and spare wet bulb wick. Replacement mercury bulbs — 1325A.

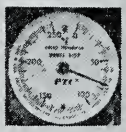
SLING PSYCHROMETER — Alcohol — 1330P — Features: A portable, pocket size, hard plastic, self-contained instrument.
Description: Psychrometers are used for ambient, relative humidity, and dewpoint temperature determinations. This psychrometer has replaceable 5" alcohol thermometers that range from 10° to 120°F. in one degree divisions. Alcohol bulbs permit use in the nuclear industry. Supplied with two thermometers and spare wet bulb wick. Replacement Alcohol Bulbs — 1330PA.



PSYCHRON — 566 — Features: Portable Electric Psychrometer, 1-3/4" x 4-1/4" x 10", operates from three size D batteries.
Description: Motor driven fan draws air across the thermometers to obtain dry and wet bulb temperetures for dewpoint and relative humidity determinations. Replaceable 9 inch thermometers range from 10° to 106°F. in one degree divisions with an accuracy of ± .3°F. Supplied complete with rugged carrying case, water vial, humidity chart, and batteries. Alcohol thermometers available for use in the nuclear industry.

HYGROTHERMOGRAPH — 594 — Features: Portable (6" x 10-1/8" x 12 1/4") spring driven temperature/humidity recorder. Accurate determinations from −30° to 110°F. and 0 to 100% relative humidity on daily or weekly charts.
Description: The instrument is manufactured to meet Weather Bureau specifications. It provides a permanent record of temperature and relative humidity on one chart on either a daily or weekly basis. The Hygrothermograph is precalibrated and supplied complete with special recording ink, weekly or daily charts, and instructions.

PSYCHROMETRIC TABLES — 235 — Standard U.S. Weather Bureau Psychrometric Tables for determining vapor pressure, relative humidity and dewpoint temperature from readings of wet and dry bulb thermometers. Table format eliminates interpolation required for standard charts. Tables cover the range from 23.0 to 30.0 inches barometric pressure.



SURFACE TEMPERATURE THERMOMETERS — PTC —

Features: Weight 2 ozs. Size: 2" diameter, approx. 1/2" high; magnetically held to ferrous surface.

Description: A PTC surface temperature thermometer consists of a cover glass, a calibrated dial and indicator in a magnetic base containing a bimetallic sensor. The thermometer reaches sensing equilibrium (stability) within three minutes to an accuracy of plus or minus 2% of the full scale range. Six models available covering temperature ranges of 0° to 750°F. and 20°C. to 400°C.

SURFACE PROFILE/CLEANLINESS

TESTEX "PRESS-O-FILM" — Features: Fast, simple, inexpensive, provides permanent record of profile.

Description: Press-O-Film tape is rubbed on to the blast cleaned surface forming an exact reverse image of the profile. The replica is measured with a spring micrometer to determine maximum peak to valley height. Tape available: Coarse 0–2.5 and X Coarse 2.5–4.5 mils. Spring micrometer graduated in .0001 inch also available.

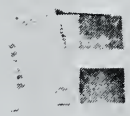
Additional Testex tapes for determining surface roughness in microinches (requires microscopic evaluation):
Fine — up to 10 microinches and
Medium — up to 80 microinches

KEANE-TATOR COMPARATOR — 372 — Features: Compact, portable, extremely durable reference discs for surface profile determinations.

Description: A field instrument designed to quickly and accurately determine the surface profile of blast cleaned surfaces. A comparator unit consists of a reference disc, a 5 X illuminated magnifier with magnetic disc holder and a vinyl disc case. A different disc is available for use on sand, shot, or grit blast cleaned surfaces. Each disc is a high purity nickel electro-formed copy of a master disc duplicated to within plus or minus 50 microinches. Blast cleaned surface is compared with the reference disc through illuminated magnifier. Discs available: For Sand (0.5 to 4.0 mils), Metallic Grit (1.5 to 5.5 mils) and Shot (2.0 to 5.5 mils) blast cleaned surfaces.

DIAL SURFACE PROFILE — 123 — Description: A dial gage for the measurement of surface profile. The measuring probe consists of a flat base with a spring loaded, hardened tip which projects into valleys of the surface to be measured. The flat base rests on the peaks and the resulting measurement is indicated on the dial which is calibrated in units of .0001" up to 0.030" (0.1 to 30 mils).

ELCOMETER ROUGHNESS — 101/45 — Features: Quick, pocket size 3 1/2" x 2" x 1" light weight, six ozs.
Description: A polished die cast aluminum case fitted with special contacts designed to slide over a rough ferrous surface indicating the average peak to valley amplitude of up to .010" on a color coded scale. Magnetically measures surface profile. Supplied complete with leather case and plastic calibration shims.



VISUAL STANDARDS

PHOTOGRAPHIC SURFACE PREPARATION STANDARDS — Description: Book of color prints illustrating the degrees of hand, powertool and blast cleaning over mill scale and various rust grades of structural steel. It is a supplement to SSPC Surface Preparation Specifications. Prepared by the Swedish Standards Institute and approved by ASTM (D2200) and SSPC (VIS 1)

HYPODERMIC NEEDLE PRESSURE GAGE — NPG-AL — Features: Pocket sized pressure gage with 2 inch circular scale.
Description: This pressure gage is adapted for use with hypodermic needles to determine blast cleaning air pressure at the nozzle. Gives instant readings from 0 to 160 psig. Complete with case, needle cover, and spare needles.

APPENDIX II
TABLE I
THE KINDS OF INDUSTRIAL PAINT AND THEIR CHARACTERISTICS

Coating Type (Formulation)	Resistance	Limitations	Features—Uses
VINYLS: Polyvinyls dissolved in aromatics, ketones or esters.	Insoluble in oils, greases, aliphatic hydrocarbons and alcohols; resistant to water and aqueous salt solutions; not attacked at room temperature by inorganic acids and alkalis. Fire resistant.	Adhesion may be poor until all the vehicle solvents have vaporized from coating. Aromatics, ketones and esters attack the coating. Thermoplastic. Relatively low thickness per coat. Temperature resistance: 180F dry, 140F wet.	Low toxicity, tasteless and odorless. Used on surfaces exposed to potable water and on sanitary equipment; widely used as industrial coatings.
CHLORINATED RUBBERS: Resins dissolved in hydrocarbon solvents.	Chemically resistant to acids and alkalis; low permeability to water vapor; abrasion resistant. Fire resistant.	Degraded by ultraviolet light. Hydrocarbon solvents attack the coating. Thermoplastic. Temperature resistance: 200F dry, 120F wet.	Excellent adherence to concrete and masonry; non-toxic. Used on structures exposed to water and marine atmospheres, i.e., swimming pools.
EPOXIES: Aliphatic polyamine plus epoxy resin.	Chemically resistant to acids, acid salts and organic solvents.	Harder and less flexible than other epoxies. Less tolerant of moisture during application. Temperature resistance: 225F dry, 190F wet.	Greatest chemical and solvent resistance of epoxies.
Polyamide plus epoxy resin.	Resistant to moisture, partially resistant to acids, acid salts and organic solvents.	Chemical resistance is inferior to that of the polyamine epoxies. Temperature resistance: 225F dry, 150F wet.	Resistant to moisture. Used on wet surfaces, or under water, as in tidal-zone areas of pilings, oil rigs, etc.
Aliphatic polyamine plus partially prepolymerized epoxy.	Partially resistant to acids, acid salts and organic solvents.	The adduct film has greater permeability than the uniformly cross-linked film of the amine epoxies. Temperature resistance: 225F dry, 150F wet.	Flexible film. Used on surfaces requiring latitude of application.
EPOXIES: Esters of epoxies and fatty acids modified.	Resistant to weathering.	Resistance to chemicals and solvents is limited. Attacked by alkalis. Temperature resistance: 225F dry.	On surfaces requiring the properties of a high-quality oil-base paint.
Coal tar plus epoxy resin.	Excellent resistance to fresh water, salt water, inorganic acids and various chemicals.	Temperature resistance: 225F dry, 150F wet.	Thick films to 10 mils. Used on clean, blast cleaned steel without a primer.

	Resistance	Limitations	Features—Uses
OIL BASED: Coating formulations with drying oils as vehicles.	Resistant to weather.	Chemical resistance is inferior to that of above coatings. Attacked by alkalis. Temperature resistance: 225F dry.	Lower cost than most coatings and the best penetrating power. Used on exterior wood surfaces, over primers requiring penetrating power, and in less severe chemical environments.
URETHANES: Urethane polymers modified with drying oils.	Resistant to abrasion; resistant to chemicals and solvents when cross-linked.	Moisture-cured types require humidity during application for best resistance. May yellow under ultraviolet light. Temperature resistance: 250F dry, 150F wet.	Ease of application, fast drying, toughness, clear or colorful formulations, high gloss and ease of cleaning. Used on furniture and floors.
Aliphatic isocyanate (reacted with polyester epoxy polyhydroxyls)	Very good chemical resistance (similar to polyamid epoxy).	Not recommended for immersion or exposure to strong acids/alkalies. Temperature resistance: 225F dry, 150F wet. Quite expensive.	Excellent gloss and color retention. Used as a decorative coating of tank cars and steel in highly corrosive environments.
SILICONES: Two types with siloxane bond: (1) high temperature (2) water repellent, in water or solvent.	Resistant (in aluminum formulation) up to 1,200F, and to weathering at lower temperatures. Resistant to water.	Requires catalyzation and baking for good cure. Water-solvent formulations should be used on limestone, cement and nonsilaceous materials; solvent formulations on bricks and nonclacareous masonry.	Stable up to 1,200F. Used on surfaces exposed to high temperature. Ease of application, low cost, porosity (for breathing), durability. Used on masonry surfaces.
WATER BASE: Aqueous emulsions of polyvinyl acetate, acrylic or butadiene-styrene latex.	Generally resistant to weather.	Limited penetrating power because binder must coalesce as water evaporates. Do not apply over bare steel.	Ease of application, minimal odor, low cost, easy clean-up, compatibility with other coatings, and good esthetics. Used in general applications.

POLYESTERS: Organic acids condensed with polybasic alcohols and cured with styrene.	Excellent resistance to acids and aliphatic solvents, good resistance to weathering.	Alkalis and most aromatic solvents soften and swell these coatings. Also, they have a short pot life and must be applied with special equipment.	Inertness, tile-like appearance, good adhesive and cohesive strength. Used as lining materials for tanks and chemical process equipment.
COAL TAR: Distilled coking by-product in aromatic solvent.	Excellent resistance to moisture, good resistance to weak acids and alkalis, petroleum oils and salts.	Exposure to ultraviolet light and weathering will degrade these coatings; and temperatures of 100F will soften them.	Used on submerged or buried steel and concrete.
ASPHALT: Solids from crude oil refining in aliphatic solvents.	Some moisture resistance, good resistance to weak acids, alkalis, salts.	Heavy dark color hides corrosion under the coating. Softens at 230F.	Better weathering and softening characteristics than coal tar. Used in aboveground weathering environments and chemical fume atmospheres.
ZINC RICH: Metallic zinc in a vehicle of organic or inorganic type.	Resistant to galvanic and pitting type corrosion.	Must have topcoat in severe environments or when pH is below 6 or above 10.5. Requires clean steel surfaces, hard to apply and topcoat.	Organic type more tolerant of surface preparation and topcoat; inorganic type more resistant to temperature (to 700F) and abrasion. Best primer to severely corrosive environments.

(Continued from page 139)
effects (moisture and oxygen transmission through the film, solvent resistance, and chemical resistance (and application effects (surface preparation and coating thickness).

Improper Application, or Mindless Neglect, Is the Cause of Roughly 80% of All Premature Coating Failures

It is one thing to obtain a good painting specification, but quite another to insure that the paint system was applied in accordance with the specification. Unfortunately, quality control is perhaps the most important single factor in coating life and one which is most neglected by industrial users.

A planned painting maintenance approach can lengthen the protective life of a coating system and reduce premature failure. It should utilize good record keeping procedures, an active painter education program and scheduled periodic inspection and touch-up painting.

Do Not Overlook the Painters

The training of painters is also very important. Painters should not just be told to paint an item; they should be applied at a certain thickness and understand the importance of proper surface preparation. A brief training program, conducted by someone other than their foreman will often answer many questions. Psychologically, the painter will realize the importance of his job and the fact that his company is concerned with proper painting. The end result cannot help but to provide better individual workmanship and ultimate savings.

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3. Chemical Engineering, "Protective Coatings," Kenneth B. Tator, McGraw Hill (October 12, 1977).
4. Chemical Engineering, "Engineered Painting Pays Off," Kenneth B. Tator, McGraw Hill (December 27, 1971).
5. Corrosion Engineering, "Paint Wisely to Save Plant Dollars," Kenneth B. Tator, Canada (March, 1971).

President Gould: Thank you Mr. Hobbs, Mr. Grove, and Mr. Tator for presenting most timely construction and maintenance projects with readily usable facts and guide lines.

This concludes today's program. Remember the REMSA banquet tonight. We will convene in the Regency Room "A" tomorrow morning at 8:30. At the close of the session tomorrow, a drawing will be held for door prizes.

TABLE II

THE PHYSICAL FUNCTIONS OF PAINTING MATERIALS

Fillers and Stoppers—Paste like materials, normally highly pigmented, used to fill imperfections (fillers) and to eliminate surface defects prior to painting operations (stoppers).

Sealers—Low viscosity materials whose primary function is to penetrate and seal porous surfaces such as cement and plaster. In certain situations they may be used instead of primers.

Primers—The first coats applied to new surfaces or to old cleaned surfaces, prior to the application of the finishing system. Primers are specifically formulated for particular substrates. All primers must possess good adhesion on the substrate.

Undercoats—Pigmented paint applied after sealing and for priming of a surface, but prior to the application of the finishing coats.

Finishes—The final coat of the paint system is formulated to provide both high durability and aesthetic value in the proposed service environment.

WEDNESDAY MORNING

September 17, 1980

NEW OFFICERS: Left to right, J. W. Chambers, President; R. C. McMaster, Sr. Vice-President; W. R. Hyma, Jr. Vice-President; Ann Wilson, Secretary; O. C. Denz, Jr. Vice-President; O. D. Anthony, Director; J. T. Kapp, Director.

President Gould: The meeting will come to order. Good morning members and guests. Welcome to the closing session of our 85th Annual Conference. Will the officers and directors please come forward to be seated.

The total registration is 789.

There are 124 ladies registered.

The following reports provide information concerning the business affairs of our Association. If you have a question regarding a specific report, please hold your questions until all reports have been presented. We will then attempt to answer your questions.

On Monday afternoon during the introduction of our officers and directors, Mrs. Ann Wilson, our secretary, was unable to be present. It is therefore a great pleasure to present her at this time.

Mrs. Wilson, will you please present your report.

Secretary's Report

Report of Membership for Period October 1, 1979 to September 1, 1980

ACTIVE MEMBERS

Total Active Members October 1, 1979	401
New Active Members since 10/1/79	38
Reinstated—paid back dues	2
Transferred from Associate	1
	442

Less: Transferred to Life	3		
Transferred to Associate	1		
Resigned	14		
Reported deceased	2		
Dropped for non-payment	11	31	
TOTAL ACTIVE MEMBERS			411

ASSOCIATE MEMBERS

Total Associate Members 10/1/79		82	
New Associate Members since 10/1/79		13	
Transferred from Active		1	
		96	
Less: resigned account retirement	2		
Dropped for non-payment	7		
Transferred to Active	1		
Transferred to Life	1	11	
TOTAL ASSOCIATE MEMBERS			85

LIFE MEMBERS

Total Life Members 10/1/79		149	
Transferred from Active		3	
Transferred from Associate		1	
		153	
Less: Reported deceased	6		
Dropped by request	1	7	
TOTAL LIFE MEMBERS			146

HONORARY MEMBERS

Total Honorary Members 10/1/79			10
TOTAL MEMBERSHIP—ALL CLASSES—September 1, 1980			652

Last Year:	Active	401
	Associate	82
	Life	149
	Honorary	10
		642

President Gould: Thank you, Mrs. Wilson. Mr. Armstrong will you please present the Treasurer's report.

Treasurer's Report

Period September 1, 1979 to August 31, 1980

Checking Account Balance August 31, 1979	$ 1,446.47

RECEIPTS:

Dues	$ 2,921.10	
1978 Advertising	14,717.14	
1977 Advertising	121.76	
Transfer of funds from S/L	6,251.18	
Sale of Brief Cases	44.00	
1979 Advertising	765.01	
1977 Proceedings	10.00	24,830.19
		$ 26,276.66

DISBURSEMENTS:

Salaries (Secretary & Assistant)	4,439.20	
FICA (On payroll)	272.16	
Office rent, telephone, etc.	525.40	
Postage	939.08	
Office Supplies	101.72	
1977 Advertising APC)	55.76	
1978 Advertising (APC)	6,025.41	
1979 Advertising (APC)	291.72	
Membership certificates	167.08	
1979 Conference Expense	1,319.45	
1978 Proceedings	5,935.76	
State of Illinois — Unemployment Tax	10.89	
Executive Board Meetings	1,077.76	
Brief Cases	3,273.40	
Printing & Stationery	661.06	
Federal Unemployment Tax	15.12	
Contributions	600.00	
Miscellaneous	208.00	25,918.97
CHECKING ACCOUNT BALANCE—August 31, 1980		$ 357.69
Homewood Federal S/L Assn. (5¼%)		108.56
Homewood Federal S/L Assn. (6¾% 8/29/80)		6,107.61
Homewood Federal S/L Assn. (6¾% 8/2/82)		2,287.59
		$8,861.45

Balance 8/31/79—$15,658.98

President Gould: Thank you, Mr. Armstrong. Mr. E. R. Schlaf, Chairman of the Auditing Committee will now present the results of the audit by his committee.

Report of Auditing Committee

September 4, 1980

TO MEMBERS OF THE AMERICAN
RAILWAY BRIDGE & BUILDING ASSOCIATION

Gentlemen:

The undersigned have examined the books of the Secretary and report of the Treasurer for the period from September 1, 1979 to August 31, 1980 inclusive and have found them to be correct as of the latter date.

Respectfully submitted,
E. R. Schlaf, Chairman
H. F. Lucas
H. M. Wilson

President Gould: Thank you, Mr. Schlaf. You have heard the reports of our Secretary, Treasurer and Auditing Committee. Is any discussion to be held regarding these reports? If not, I entertain a motion that the reports be accepted as given. Do I hear a second? It has been moved and seconded that the reports be accepted. All in favor Aye—oppose No. The motion is carried and the reports are accepted.

Paul Saletnik, Chairman of the Resolutions Committee will give the committee report.

Report of Resolutions Committee

MR. PRESIDENT, as a token of appreciation for the time and effort certain individuals and organizations have contributed to make this, the 85th Meeting in the 90th year of the American Railway Bridge & Building Association an outstanding success, the resolutions committee presents the following resolutions:

BE IT HEREBY RESOLVED that the thanks of the Association be extended to Rev. LeRoy Cronkhite II, Pastor, Central Church, Chicago, who was so kind to come among us and invoke the blessing for spiritual assurance.

BE IT FURTHER RESOLVED that the thanks of the Association be expressed to the prominent speakers who gave of their time and so capably shared their knowledge and counsel with us, especially, A.R.E.A. President, M. Rougas; REMSA President, Owen Buscho; REMSA first vice president, C. L. Coy; Mr. R. L. Richmond, vice-president-operations, Union Pacific R.R.; Mr. Brad Purinton for his presentation on "Reinforced Earth"; Dr. Karel Klima and Mr. Robert H. Bauer from the U.S. D.O.E.; Mr. G. R. MacNiece, chief engineer, National Railways of Mexico; Mr. Tracy Kelly, president, American National Bank; J. (Jack) Burke, mgr., Railroad Products, CF&I Steel Corporation; Ms. Yvonne Method-Walker, management development officer, Union Pacific; D. A. Bessey, asst. chief engr. structures, Milwaukee Road; Mr. J. C. Hobbs, chief engr., Richmond, Fredericksburg & Potomac; Mr. Ken Tator of Ken Tator Associates.

BE IT FURTHER RESOLVED that our thanks be expressed to Mrs. D. G. Gale and Mrs. D. C. Gould and their committees for their efforts in arranging registration and entertainment for our wives and to the untiring efforts of the ladies who assisted with registration.

AND, BE IT FINALLY RESOLVED that the Association express its thanks to its chairmen and their committees for their work in preparing the reports which were presented at the meeting, also to the Railway companies who provided assistance at the Registration desk; to REMSA and all its members for the fine banquet we enjoyed last evening and as well as to the members of our executive com-

mittee and to our President Mr. D. C. Gould, who has spent so much of his own time and effort in guiding the affairs of our Association over the past year.

MR. PRESIDENT, we recommend these resolutions be made a part of the official record of this association and that copies be presented to all concerned parties.

Respectfully submitted,
Paul H. Saletnik, Chairman

President Gould: Thank you, Mr. Saletnik. I now call Mr. Gunkle to the rostrum to give the report of the Necrology Committee.

Report of Necrology Committee

To the President and Members of the
AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION:

It is with grief and regret that we report the known loss of eight (8) members through death during the past year. It is possible that other members have passed away during the year of whom we have no information. If you know of any, please report their names to the Secretary. The following have been reported since our last Annual Conference in September 1979.

Active Members	Title-Railroad-Location	Joined	Deceased
J. L. Hartley	Master Carpenter Seaboard Coast Line Atlanta, Ga.	1968	1980
M. B. Miller	Asst. Engr. Standards ConRail Philadelphia, Pa.	1968	1980
Life Members			
P. L. Koehler	Div. Supt. Chessie System Huntington, W. Va.	1938	1980
A. S. Krefting	Chief Engineer Soo Line Minneapolis, Mn.	1935	1975
F. O. McGrew	Chief Carpenter C.M.S.P.&P. Delphi, Ind.	1948	1980
D. H. McKibben	Engineer Structures ConRail Pittsburgh, Pa.	1951	1979

B. F. Manley	B.&B. Supvr. Pacific Electric Rwy. Co. Los Angeles, Ca.	1943	1979
W. R. Meeks	B.&B. Supvr. Missouri Pacific R.R. Co. Lincoln, Nebr.	1942	1979

Respectfully submitted,

W. J. Gunkle, Chairman

President Gould: Thank you, Mr. Gunkle. In remembrance of these members, let us stand in a moment of silence. (Pause)

The nominating committee is composed of the five most recent Past Presidents. I ask Mr. Sturm, Chairman of the Nominating Committee to please come forward to present the selection of the committee for officers and directors to serve for the coming year.

Report of Nominating Committee

Mr. Sturm: The Nominating Committee of the American Railway Bridge and Building Association respectfully submits to the membership the following slate of candidates for officers and directors of the Association.

For Directors for Terms expiring in 1983—

O. D. Anthony, Asst. Chief Engineer
Bangor and Aroostook Railroad
J. T. Kapp, Structural Inspector, ConRail
D. J. Lewis, Designer, Illinois Central Gulf Railroad

For Treasurer—

W. F. Armstrong, Engineer Buildings
Chicago and Northwestern Railroad

For Secretary—

Mrs. Ann Wilson

For Junior Vice Presidents—

O. C. Denz, Supervisor Building Maintenance, Milwaukee Road
W. R. Hyma, Bridge Engineer System, Santa Fe

For Senior Vice President—

R. C. McMaster, Manager Facilities and Structures
Bessemer and Lake Erie Railroad

Advancing to President according to Article 6 of the Constitution is J. W. Chambers, Bridge Construction Engineer, Missouri Pacific Railroad.

Mr. President, it is the recommendation of the Nominating Committee that this slate of candidates be elected for the terms specified.

President Gould: Any nominations from the floor? Since no additional nominations have been made, I entertain a motion to elect the slate as presented, unanimously. Motion has been made Do I hear a second? Those in favor indicate by saying Aye—Oppose No. The motion is carried.

Will the new officers please come forward. You are now duly installed.

Gentlemen, here are your Association's officers for the coming year.

Mr. W. R. Hyma will please come forward to introduce the Chairman of Special Subjects Committee #3.

Mr. Hyma: Mr. J. T. Kapp, Project Engineer, ConRail, of West Chester, Pennsylvania, will speak on the subject of "The Selection of Materials for Building Finishes."

The Selection of Materials for Building Finishes

REPORT OF SPECIAL COMMITTEE NO. 3

COMMITTEE—J. T. KAPP, *Chairman*, proj. engr., ConRail; R. M. OVELMAN, *Vice Chairman*, mgr. arch. dsgn., Amtrak; O. D. ANTHONY, asst. ch. engr. br. & struct., Bangor & Aroostook R.R.; A. S. DRESDEN, tech. field adv., Maco Coatings, Inc.; J. G. ROBERTSON, mgr. engrg. dsgn., B.&L.E. R.R. Co.; E. E. RUNDE, (Ret.), E. Dubuque, Ill.; P. SALETNIK, asst. engr. bldgs., C.&N.W. Transportation Co.; W. C. STURM, sr. proj. engr., E.J.&E. Rwy. Co.

The choices a company makes when selecting materials for the betterment of an existing building, or the construction of a new facility, can return to haunt both the owner and the occupant in future years. Which material will last the longest while retaining its original aesthetic value? Maintenance, insulating values and guarantees, all relate to the main thought in an architect's mind when he specifies a material for any project: which selection will achieve the lowest total capital outlay over a given period of years, while creating an environment typical of the building usage?

The designer relies on the past performance of previously specified materials and the manufacturer's information concerning new products. In addition, the availability of materials, the geographical locale and function of the building play important roles in his decision. Owners must be concerned with capital available and the work force involved with the construction.

The observations that follow will reflect certain parameters that affect the selection of the materials used for construction that today's society demands. The carefree attitude of both the public and the owner's workers requires a material capable of withstanding vandalism and hard industrial usage.

J. T. Kapp

To better demonstrate the best use of a material, railroad facilities can gen-

erally be established in three major areas: operational, administrative and public. Operational facilities would include those used for the maintenance and repair of rolling stock and company equipment, towers, warehouses and welfare building. The administrative group would include offices and computer centers. The public group would cover city sales offices, freight terminals and stations.

Operational

Of the three groups chosen, the operational buildings are where the real work of keeping a railroad moving takes place. For this reason, it is important that these structures be equally qualified to: (1) withstand rough usage, and (2) produce an environment conducive to work.

A wide selection of materials is available for exterior walls, including concrete, masonry units and brick. Metal siding of varying types can be used but should be kept at least eight feet above any horizontal work area. Impact forces can cause damage to both the siding and interior support columns, and additionally, rusting will occur in any areas where water is used and the metal building comes in its contact.

Concrete Used in Different Ways

Concrete can be used in several different ways including cast-in-place and pre-fabricated panels. Cast-in-place concrete limits the owner to natural color unless an additive is used when mixing. The painting of concrete should be avoided to prevent unsightly peeling and the continual upkeep.

The pre-cast units consist of reinforced concrete with a decorative facing. A unit is used to face buildings and can be anchored to both steel and concrete. These units can be erected during cold weather with the joints between units being filled with an elastometric material in warmer weather. The use of these units is made economical by mass-production methods that reuse the same form-work.

Masonry Units

Masonry units are excellent for operational buildings because they are economical, durable, allow for sound control, have a good fire rating and can be installed rapidly. They can be obtained in various colors to make a better work environment and eliminate the need for painting or other surface treatments. In areas where dirt or oil splashes cannot be prevented, a dark color block is the most practical.

Hollow and solid block are used for exterior walls depending on the amount of weight to be supported and the weight factor of the wall itself. Block walls are limited in the distance between lateral supports as well as the height of the building. A 12-inch hollow block wall cannot exceed 35 feet without additional supports. Time must be taken to place conduits and loose insulation or polyurethane inserts in the wall as it is being laid unless factory installed inserts are used.

Concrete block does provide a watertight outer surface when a sealer coat or silicone penetrant and compatible paint are applied. Without the proper application of these sealers, water will penetrate normal block.

A splitblock masonry unit is an ideal outer surface in rough usage areas because the block maintains its aesthetic value even when damaged. The user of this block must inspect them for uniformity or an uneven surface will result. Color selection is also limited depending on the locale.

Another type of block is the groundface masonry unit. The exposed faces are ground, polished and sealed with three coats of a resin base acrylic which is absorbed by the block. The block shown has a face of 8″ x 16″ with a vertical score for an effective 8″ x 8″ face. The surface is resistant to stain and water and acts as both an inner and outer surface for this tower.

Block Best for Interior Walls

Non-loading bearing block is the best material for interior walls because of its durability. Drywall should be avoided in operational buildings. When it is used, a durable wainscot such as plywood or steel plates is required. If reduced maintenance forces are a major concern, epoxy paint provides years of service at an expensive price. To reduce its cost, a six-foot wainscot is recommended with the use of semi-gloss paint above. In no case should a flat paint be used. Light colors are preferable for interior walls as they provide a more reflective surface for lighting.

Concrete Best for Floors

The best material for the floor is concrete. Technical advances in admixtures have produced chemicals capable of: (1) restricting oil penetration, and (2) hardening the surface to prevent "dusting" and nicks or chips caused by dropped tools and equipment. Other systems such as wood block and composition floors are available but their use is inhibited by high cost and lower durability.

The materials discussed previously apply to most operational buildings except for two specific applications:

Welfare Facility Ceilings—A more finished area is required to provide a different atmosphere from the normal work area. Noise control is important and both of these objectives can be accomplished through the use of accoustical lay-in ceilings. Rigid material in lieu of batt type should be used for durability. A heavily textured material will collect dirt, dust, and nicotine stains, and should be avoided. Toilet ceilings should be a hard finished material such as dry-walls. Acoustical tile will absorb odors.

Toilet Walls and Floors—Ceramic tile is a must for walls and floors to prevent odors. Epoxy wall and floor coatings require periodic resurfacing every ten years. Quarry tile should not be used because it also is an absorbative. Where water damage can occur, an epoxy grout should be used with the ceramic tile.

Toilet stalls should be either stainless steel or baked-on porcelain enamel to avoid rusting.

Vinyl asbestos tile floors are economical and afford an easily maintained floor surface. Quarry tile offers the best long term value because of its durability and resistance to grease stains, but has a high initial cost.

Administrative

The use of materials in administrative facilities is dictated by the company's public image and the future development of a building. The flexibility to expand is essential.

Although the materials used for exterior walls in operational buildings can be extended, they require a major reconstruction in some cases. Curtain walls of wood and metal are a choice which can be modified more easily.

In the past wood was inexpensive, abundant and could easily be shaped by field forces. Its drawbacks included the maintenance required to protect any exposed surfaces, insect infestation, and susceptibility to fire and water penetration. Today, better wood treatments and preservatives have overcome these problems.

Wood is also being used to shingle the exterior of buildings with a structural steel frame. By providing a surface which will accept the shingles and which can be readily attached to the steel framework, a curtain wall can be constructed which carries no load but has the principal function of keeping the wind and weather out of a structure. Number one, extra clear white cedar shingles, 6″ in length and with a 5″ exposure, were given a factory applied preservative and two coats of exterior stain upon the completion of their installation. This material was selected because of its ease of installation and an anticipated life expectancy of 15 years.

Curtain walls are not limited to wood

but are used extensively with metal sidings. But the metal sidings on older buildings have presented problems through poor appearance and by not being weather-tight. Stiffer corrugations, thicker gages, interlocking ribs and better coatings with guarantees of 20 years have contributed to make a product that is both lasting and versatile.

Building Codes Dictate Materials Used

Local building codes often dictate both the thickness and type of material used in siding because of fire resistance. Specifications for siding dictate that all fasteners be concealed and noncorrosive, that the panels be installed full length with no splices, and that the lay-out around all openings be symmetrical. Most panels can be installed by the owner's forces, but a factory authorized installer is usually required when the work is contracted. Detailing provided by the manufacturer has proven to be watertight and quite satisfactory when used with the proper flashing or caulking. Requirements for the siding usually include a manufacturer, with alternates. a typical cross-section, and a choice of aluminum, steel, aggregate, or various sandwich panels.

Exterior Walls

Sandwich panels are pre-fabricated curtain walls with an acoustical insulation core placed between thin, lightweight facing and back materials to which the siding is attached. This provides better insulating properties than normal siding which uses a dead air space or insulating material placed against the exposed wall as a backup. The edges of sandwich panels are sealed except for small holes which act as a release for the sizeable vapor pressure. The panels are attached to the main structural steel and secondary framing members with connections that allow for the difference in expansion and contraction at points of support with the adjoining steelwork. Electrical wiring and ductwork must be detailed by the owner before placing his order. This allows for complex connections which usually require a contractor experienced with sandwich panel construction. In addition, special detailing is needed for a weathertight seal. This system is somewhat inflexible if future additions are being considered because of the detailing mentioned previously.

A typical reinforced aluminum panel would consist of a polyurethane core between two sheets of aluminum with 1/8" thick cement asbestos board inserted between the core and the aluminum material. These panels are then factory installed in a wall system and retained by an aluminum bead with a color coordinated silicone caulk used to seal between the bead and panel. Other outside materials include aggregate set in an epoxy matrix and porcelain enamel which comes with a ten-year warranty.

Interior Walls

For the interior walls of administrative buildings, drywall on steel studding is perhaps the best material. Drywall is economical, easily removed for renovations and with the proper covering, maintains an unmarred surface. Corner guards are a necessity where mail or delivery carts are used. The use of vinyl wall coverings with a protective coating makes an excellent surface for both offices and corridors. A semi-gloss should be used when painting interior walls. Flat paint is easily marred in normal use and is extremely difficult to clean.

Open-space wall systems are used in many offices. Partitions of a five or six-foot height are used to make better use of lighting and central heating and air-conditioning.

Floors

Vinyl asbestos floors are easily maintained in administrative buildings but lack warmth. In recent years, advances have been made in the carpet industry that make their choice a practical one for offices to permit privacy even in open

space systems. A concealed hanger system puts unwanted pipes and wires out of sight yet allows accessibility and the freedom to renovate.

Public

To make the proper impression on the customer, a public facility should incorporate aesthetically pleasing materials. These materials are more costly, but the business created by a richer atmosphere allows the additional expenditure to pay for itself.

Exterior Walls

In past years, the giant train stations have had exterior walls and floors of granite, marble and brick. Today, availability of materials and the restrained budget of the railroads make brick a good choice when used properly. Drawbacks to brick include its original cost and, without a good manufacturer and bricklayer, soluable salts in the form of a whitish powder, referred to as efflorescence, will appear on the completed brickwork, marring its finish. A combination of requirements including: (1) manufacturer, (2) compressive strength, and (3) cost per thousand brick can be used to avoid this flaw. In addition, the mortar mixture to be used should be tested by the construction inspector or a test wall erected prior to actual bricklaying. The compressive strength of brick usually exceeds 10,000 psi and the elasticity of the bonding mortar allows for walls of two hundred feet in length with no expansion joint. Brick can be used much as pre-fabricated panels for a facade.

Interior Walls

Interior walls should not be of drywall due to abuse. Plaster should be used covered with vinyl wall coverings which can be easily cleaned. Cleaning is facilitated by the use of heavy duty coverings with a protective coating. Heavy textured vinyls should be avoided. Ceramic tile is required the full height of restrooms to promote cleanliness.

Ceilings

Budget considerations dictate the choice of many ceilings available. Metal slats, wood, or tile are part of the wide variety of materials that can be used as ceilings in public buildings. The choice depends upon the overall environment set by the walls, floors and decor chosen for a given setting.

The materials for any railroad building are interchangeable to a certain degree. Vinyl covered walls are not the choice for an engine house, concrete block does not give the warmth needed for a train station or office. Metal sidings can be used, with restrictions, in all buildings listed.

Materials Promote Positive Corporate Image

The choices made by a company involving building materials can promote a positive corporate image by generating revenue. The costs of maintenance, heating, fire insurance and the original capital expenditure must all be considered. The money required to heat a new building and pay its fire insurance can be so large that the increase in business the building generates is not enough to offset the increased costs. The buildings function, the work environment, the availability of materials and the availability and skill of the work force are factors that must be weighed. All of these considerations will allow the architect to select materials that have the lowest overall cost without short changing the worker, the public, and the owner of the beauty they deserve in a modern building.

It should be apparent by now that the selection of materials must be made with good common sense judgment. Where a material is slected for low cost only, a premium will be paid every day after completion in higher maintenance and operating costs. In a very short time, these costs can exceed any "sav-

ings" on the capital investment.

Assistance in preparing this report was furnished by:

Mr. William Humphreys—ConRail
Mr. George Fabrin—Southern Pacific Transportation Co.
Mr. James Michel—Amtrak
Mr. D. R. Ladner—Chicago & Northwestern Transportation Co.

President Gould: Thank you, Mr. Kapp, for that interesting report.

Our Association each year elects three members to serve as Directors for three years. I, personally, and, on behalf of the Association, want to thank our three out-going directors, Mr. Omar Denz, Mr. Bill Gunkle, and Mr. Bill Stokely, for their many years of dedicated service to the Association and for assisting me in my term as President. Will Messrs. Denz, Gunkle and Stokely please come forward.

As an expression of the Association's appreciation of your service I present these plaques.

(Present Plaques)

Omar Denz - Bill Gunkle - Bill Stokely.

As this is my final appearance before you as President, I want to express my appreciation and thank the officers, directors, Ann Wilson, and members of the Association for making my term most enjoyable. I have come to know how hard the officers work to make the ARB&BA the recognized Railroad Association it is.

You have heard enough of me in the past two days. I plan to be active in the Association and contribute to future Conferences. Old presidents of the ARB&BA do not sit back. They just step aside for the future to progress.

Thank you.

(Mr. Joe Chambers Acceptance Speech)

Friends and members, I wish to express my pleasure and appreciation for the honor of being your president for the next year.

I will do my best to carry on the fine accomplishments of my many predecessors.

As with all active organizations, the key word is help.

For me, in the coming year, I have it all. The list of officers for the coming year is outstanding.

Those officers and directors who have been with us have proven themselves.

Those who are newly elected have shown by their past interest and participation that they are willing to put in the effort required.

These officers are the ones who need your help. Remember, if you are called upon to contribute to a committee report or maybe be a committee chairman, it only takes a little effort by each of several members to make a report, but it takes a large effort by a lonely committee chairman to make a report all by himself.

Now then! My first official act is to recognize the outstanding work and efforts of our immediate past president, Mr. Don Gould.

We have had another great year and as a remembrance of his term as our President, I am pleased to present him with this placque.

Mr. Gould will continue as an active member of the executive committee as a president.

Do we have any other matters which should be brought before this committee?

I now declare the 85th Annual Conference of the American Railway Bridge and Building Association to be adjourned.

Will the members of the Executive Committee please assemble at the front?

We will now have the drawing for the door prize. Does every one have his name tag in the box for the drawing—YOU HAVE TO BE PRESENT TO WIN.

Please bring the box forward.

Member of audience pick (draw) a name.

Read name, etc.

Past Officers

	1891-1892	1892-1893	1893-1894	1894-1895
President	O. J. Travis	H. M. Hall	J. E. Wallace	Geo. W. Andrews
1st V.-Pres.	H. M. Hall	J. E. Wallace	Geo. W. Andrews	W. A. McGonagle
2nd V.-Pres.	J. B. Mitchell	G. W. Hinman	W. A. McGonagle	L. K. Spafford
3rd V.-Pres.	James Stannard	N. W. Thompson	L. K. Spafford	James Stannard
4th V.-Pres.	G. W. Hinman	C. T. Fuller	E. D. Hines	Walter G. Berg
Secretary	C. W. Gooch	S. F. Patterson	S. F Patterson	S. F. Patterson
Treasurer	George M. Reid	George M. Reid	George M. Reid	George M. Reid
Executive Members	W. R. Damon	G. W. Andrews	Q. McNab	James Stannard
	G. W. Markley	J. M. Staten	A. S. Markley	James H. Travis
	W. A. McGonagle	J. M. Caldwell	Floyd Ingram	J. H. Cummin
	C. W. McGehee	Q. McNab	James Stannard	R. M. Peck
	G. W. Turner	Floyd Ingram	James H. Travis	J. L. White
	J. E. Wallace	A. S. Markley	J. H. Cummin	A. Shane

	1895-1896	1896-1897	1897-1898	1898-1899
President	W. A. McGonagle	James Stannard	Walter G. Berg	J. M. Cummin
1st V.-Pres.	L. K. Spafford	Walter G. Berg	J. H. Cummin	A. S. Markley
2nd V.-Pres.	James Stannard	J. H. Cummin	A. S. Markley	C. C. Mallard
3rd V.-Pres.	Walter G. Berg	A. S. Markley	G. W. Hinman	W. A. Rogers
4th V.-Pres.	J. H. Cummin	R. M. Peck	C. C. Mallard	J. M. Staten
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	George M. Reid	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	R. M. Peck	W. O. Eggleston	G. J. Bishop	Wm. S. Danes
	L. J. White	W. M. Noon	C. P. Austin	J. H. Markley
	A. Shane	J. M. Staten	M. Riney	W. O. Eggleston
	A. S. Markley	G. J. Bishop	Wm. S. Danes	R. L. Heflin
	W. M. Noon	C. P. Austin	J. H. Markley	F. W. Tanner
	J. M. Staten	M. Riney	W. O. Eggleston	A. Zimmerman

	1899-1900	1900-1901	1901-1902	1902-1903
President	Aaron S. Markley	W. A. Rogers	W. S. Danes	B. F. Pickering
1st V.-Pres.	W. A. Rogers	W. S. Danes	B. F. Pickering	C. C. Mallard
2nd V.-Pres.	J. M. Staten	B. G. Pickering	A. Shane	A. Shane
3rd V.-Pres.	Wm. S. Danes	A. Shane	A. Zimmerman	A. Zimmerman
4th V.-Pres.	B. F. Pickering	A. Zimmerman	C. C. Mallard	A. Montzheimer
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	N. W. Thompson	N. W. Thompson	N. W. Thompson	N. W. Thompson
Executive Members	T. M. Strain	T. M. Strain	A. Montzheimer	W. E. Smith
	R. L. Heflin	H. D. Cleaveland	W. E. Smith	A. W. Merrick
	F. W. Tanner	F. W. Turner	A. W. Merrick	C. P. Austin
	A. Zimmerman	A. Montzheimer	C. P. Austin	C. A. Lichty
	H. D. Cleaveland	W. E. Smith	C. A. Lichty	W. O. Eggleston
	A. Montzheimer	A. W. Merrick	W. O. Eggleston	J. H. Markley

	1903-1904	1904-1905	1905-1906	1906-1907
President	A. Montzheimer	C. A. Lichty	J. B. Sheldon	J. H. Markley
1st V.-Pres.	A. Shane	J. B. Sheldon	J. H. Markley	R. H. Reid
2nd V.-Pres.	C. A. Lichty	J. H. Markley	R. H. Reid	J. P. Canty
3rd V.-Pres.	J. B. Sheldon	R. H. Reid	R. C. Sattley	H. Rettinghouse
4th V.-Pres.	J. H. Markley	R. C. Sattley	J. P. Canty	F. E. Schall
Secretary	S. F. Patterson	S. F. Patterson	S. F. Patterson	S. F. Patterson
Treasurer	C. P. Austin	C. P. Austin	C. P. Austin	C. P. Austin
Executive Members	R. H. Reid	W. O. Eggleston	H. Rettinghouse	W. O. Eggleston
	W. O. Eggleston	A. E. Killam	A. E. Killam	A. E. Killam
	A. E. Killam	H. Rettinghouse	J. S. Lemond	J. S. Lemond
	R. C. Sattley	J. S. Lemond	C. W. Richey	C. W. Richey
	H. Rettinghouse	W. H. Finley	W. O. Eggleston	H. H. Eggleston
	J. S. Lemond	C. W. Richey	F. E. Schall	B. J. Sweatt

	1907-1908	1908-1909	1909-1910	1910-1911
President	R. H. Reid	J. P. Canty	H. Rettinghouse	H. Rettinghouse
1st V.-Pres.	J. P. Canty	H. Rettinghouse	J. S. Lemond	F. E. Schall
2nd V.-Pres.	H. Rettinghouse	F. E. Schall	F. E. Schall	A. E. Killam
3rd V.-Pres.	F. E. Schall	J. S. Lemond	A. E. Killam	J. N. Penwell
4th V.-Pres.	W. O. Eggleston	A. E. Killam	J. N. Penwell	L. D. Hadwen
Secretary	S. F. Patterson	S. F. Patterson	C. A. Lichty	C. A. Lichty
Treasurer	C. P. Austin	C. P. Austin	J. P. Canty	J. P. Canty
Executive Members	A. E. Killam	J. N. Penwell	W. Beahan	T. J. Fullem
	J. S. Lemond	Willard Beahan	F. B. Scheetz	G. Aldrich
	C. W. Richey	F. B. Scheetz	L. D. Hadwen	P. Swenson
	T. S. Leake	W. H. Finley	T. J. Fullem	G. W. Rear
	W. H. Finley	L. D. Hadwen	G. Aldrich	W. O. Egglestoo
	J. N. Penwell	T. J. Fullem	P. Swenson	W. F. Steffens

	1911-1912	1912-1913	1913-1914	1914-1915
President	F. E. Schall	A. E. Killam	J. N. Penwell	L. D. Hadwen
1st V.-Pres.	A. E. Killam	J. N. Penwell	L. D. Hadwen	G. Aldrich
2nd V.-Pres.	J. N. Penwell	L. D. Hadwen	G. Aldrich	G. W. Rear
3rd V.-Pres.	L. D. Hadwen	T. J. Fullem	G. W. Rear	C. E. Smith
4th V.-Pres.	T. J. Fullen	G. Aldrich	C. E. Smith	E. B. Ashby
Secretary	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Treasurer	J. P. Canty	J. P. Canty	J. P. Canty	F. E. Weise
Executive Members	G. Aldrich	G. W. Rear	W. F. Steffens	W. F. Steffens
	P. Swenson	W. F. Steffens	E. B. Ashby	S. C. Tanner
	G. W. Rear	E. B. Ashby	S. C. Tanner	Lee Jutton
	W. F. Steffens	C. E. Smith	Lee Jutton	F. F. Strouse
	E. B. Ashby	S. C. Tanner	W. F. Strouse	C. R. Knowles
	W. O. Eggleston	Lee Jutton	C. R. Knowles	A. Ridgway

	1915-1916	1916-1917	1917-1918	1918-1919
President	G. W. Rear	C. E. Smith	S. C. Tanner	Lee Jutton
1st V.-Pres.	C. E. Smith	E. B. Ashby	Lee Jutton	F. E. Weise
2nd V.-Pres.	E. B. Ashby	S. C. Tanner	F. E. Weise	W. F. Strouse
3rd V.-Pres.	S. C. Tanner	Lee Jutton	W. F. Strouse	C. R. Knowles
4th V.-Pres.	Lee Jutton	F. E. Weise	C. R. Knowles	A. Ridgway
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Executive Members	F. E. Weise	W. F. Strouse	A. Ridgway	J. S. Robinson
	W. F. Strouse	C. R. Knowles	J. S. Robinson	J. P. Wood
	C. R. Knowles	A. Ridgway	J. P. Wood	A. B. McVay
	A. Ridgway	J. S. Robinson	D. C. Zook	J. H. Johnston
	J. S. Robinson	J. P. Wood	A. B. McVay	E. T. Howson
	J. P. Wood	D. C. Zook	J. H. Johnston	C. W. Wright

	1919-1920	1920-1921	1921-1922	1922-1923
President	F. E. Weise	W. F. Strouse	C. R. Knowles	Arthur Ridgway
1st V.-Pres.	W. F. Strouse	C. R. Knowles	A. Ridgway	J. P. Wood
2nd V.-Pres.	C. R. Knowles	A. Ridgway	J. S. Robinson	J. S. Robinson
3rd V.-Pres.	A. Ridgway	J. S. Robinson	J. P. Wood	C. W. Wright
4th V.-Pres.	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.			F. E. Weise	F. E. Weise
Directors	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
	A. B. McVay	A. B. McVay	J. H. Johnston	Maro Johnson
	J. H. Johnston	G. A. Manthey	E. K. Barrett	O. F. Dalstrom
	E. T. Howson	E. T. Howson	F. C. Baluss	S. D. Corey
	C. W. Wright	J. H. Johnston	Maro Johnson	W. B. Hotson
	G. A. Manthey	E. K. Barrett	O. F. Dalstrom	P. N. Nelson

	1923-1924	1924-1925	1925-1926	1926-1927
President	J. S. Robinson	J. P. Wood	C. W. Wright	E. T. Howson
1st V.-Pres.	J. P. Wood	C. W. Wright	E. T. Howson	F. C. Baluss
2nd V.-Pres.	C. W. Wright	E. T. Howson	F. C. Baluss	Maro Johnson
3rd V.-Pres.	E. T. Howson	F. C. Baluss	Maro Johnson	J. S. Huntoon
4th V.-Pres.	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise	F. E. Weise	F. E. Weise
Directors	S. T. Corey	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
	W. B. Hotson	A. I. Gauthier	W. B. Hotson	E. L. Sinclair
	P. N. Nelson	E. L. Sinclair	P. N. Nelson	P. F. Dalstrom
	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	W. T. Krausch
	A. I. Gauthier	W. B. Hotson	E. L. Sinclair	R. C. Bardwell
	E. L. Sinclair	P. N. Nelson	O. F. Dalstrom	H. I. Benjamin

	1927-1928	1928-1929	1929-1930	1930-1934
President	F. C. Baluss	Maro Johnson	J. S. Huntoon	C. S. Heritage
1st V.-Pres.	Maro Johnson	J. S. Huntoon	C. S. Heritage	A. I. Gauthier
2nd V.-Pres.	J. S. Huntoon	C. S. Heritage	A. I. Gauthier	H. I. Benjamin
3rd V.-Pres.	C. S. Heritage	A. I. Gauthier	H. I. Benjamin	W. T. Kransch
4th V.-Pres.	A. I. Gauthier	H. I. Benjamin	W. T. Krausch	T. H. Strate
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Asst. Sec.	F. E. Weise	F. E. Weise		
Directors	W. T. Krausch	R. C. Henderson	G. A. Rodman	E. C. Neville
	R. C. Bardwell	J. S. Ekey	W. A. Batey	H. H. Best
	H. I. Benjamin	T. H. Strate	F. W. Hillman	J. E. King
	R. C. Henderson	G. A. Rodman	E. C. Neville	A. B. Scowden
	T. H. Strate	W. A. Batey	H. H. Best	W. A. Batey
	J. S. Ekey	F. W. Hillman	J. E. King	L. C. Smith

	1934-1935	1935-1936	1936-1937	1937-1938
President	H. I. Benjamin	T. H. Strate	E. C. Neville	C. M. Burpee
1st V.-Pres.	T. H. Strate	E. C. Neville	C. M. Burpee	F. H. Masters
2nd V.-Pres.	E. C. Neville	C. M. Burpee	F. H. Masters	W. S. Lacher
3rd V.-Pres.	A. B. Scowden	F. H. Masters	C. A. J. Richards	C. A. J. Richards
4th V.-Pres.	W. R. Roof	C. A. J. Richards	W. S. Lacher	F. H. Cramer
Sec.-Treas.	C. A. Lichty	C. A. Lichty	C. A. Lichty	C. A. Lichty
Directors	C. M. Burpee	A. L. McCloy	W. R. Roof	B. R. Meyers
	W. A. Batey	R. P. Luck	T. P. Soule	G. S. Crites
	L. C. Smith	H. H. Best	F. H. Cramer	R. E. Dove
	C. A. J. Richards	W. R. Roof	B. R. Meyers	T. P. Soule
	A. L. McCoy	T. P. Soule	G. S. Crites	A. Chinn
	R. P. Luck	F. H. Cramer	R. E. Dove	L. G. Byrd

	1938-1939	1939-1940	1940-1941	1941-1942
President	Armstrong Chinn	A. E. Bechtelheimer	H. M. Church	R. E. Dove
1st V.-Pres.	F. H. Cramer	F. H. Cramer	R. E. Dove	F. H. Soothill
2nd V.-Pres.	A. E. Bechtelheimer	H. M. Church	F. A. Soothill	G. S. Crites
3rd V.-Pres.	H. M. Church	R. E. Dove	G. S. Crites	A. M. Knowles
4th V.-Pres.	R. E. Dove	F. H. Soothill	A. M. Knowles	N. D. Howard
Sec.-Treas.	C. A. Lichty	C. A. Lichty		
Secretary	.....	.....	F. O. Whiteman	A. G. Shaver
Treasurer	.....	.....	F. E. Weise	F. E. Weise
Directors	L. G. Byrd	B. R. Meyers	N. D. Howard	R. E. Caudle
	W. R. Ganser	W. Walkden	L. G. Byrd	I. A. Moore
	F. H. Soothill	A. S. Krefting	K. L. Miner	W. A. Sweet
	B. R. Meyers	A. M. Knowles	R. E. Caudle	J. L. Varker
	W. Walkden	L. G. Byrd	I. A. Moore	L. E. Peyser
	A. S. Krefting	K. L. Miner	W. A. Sweet	Martin Meyer

	1942-1943	1943-1944	1944-1945	1945-1946
President	G. S. Crites	J. L. Varker	J. L. Varker	N. D. Howard
1st V.-Pres.	R. E. Caudle	R. E. Caudle	R. E. Caudle	F. G. Campbell
2nd V.-Pres.	A. M. Knowles	N. D. Howard	N. D. Howard	J. S. Hancock
3rd V.-Pres.	N. D. Howard	F. G. Campbell	F. G. Campbell	E. H. Barnhart
4th V.-Pres.	J. L. Varker	J. S. Hancock	J. S. Hancock	W. F. Martens
Secretary	A. G. Shaver†	Elinor V. Heffern	Elise LaChance	Elise LaChance
	Lorene Kindred‡			
	Elinor V. Heffern			
Treasurer	F. E. Weise	C. R. Knowles	C. R. Knowles	C. R. Knowles
Treasurer Emeritus		F. E. Weise	F. E. Weise	
Directors	M. Meyer	W. F. Martens	W. F. Martens	A. B. Chapman
	L. E. Peyser	A. L. McCloy	A. L. McCloy	W. A. Huckstep
	K. L. Miner	L. C. Winkelhaus	L. C. Winkelhaus	F. R. Spofford
	F. G. Campbell	E. H. Barnhart	E. H. Barnhart	Guy E. Martin
	J. S. Hancock	A. B. Chapman	A. B. Chapman	B. R. Meyers
	L. C. Winkelhaus	L. E. Peyser	L. E. Peyser	L. E. Peyser

† To November 1, 1962 ‡ To February 1, 1943

	1946-1947	1947-1948	1948-1949	1949-1950
President	F. G. Campbell	J. S. Hancock	E. H. Barnhart	W. F. Martens
1st V.-Pres.	J. S. Hancock	E. H. Barnhart	W. F. Martens	W. A. Huckstep
2nd V.-Pres.	E. H. Barnhart	W. F. Martens	W. A. Huckstep	Guy E. Martin
3rd V.-Pres.	W. F. Martens	W. A. Huckstep	Guy E. Martin	F. R. Spofford
4th V.-Pres.	W. A. Huckstep	G. E. Martin	F. R. Spofford	Lee Mayfield
Treasurer	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	C. R. Knowles	C. R. Knowles	L. C. Winkelhaus	L. C. Winkelhaus
Directors	Guy E. Martin	H. M. Harlow	Lee Mayfield	H. M. Harlow
	B. R. Meyers	H. B. Christianson	F. M. Misch	V. E. Engman
	L. E. Peyser	F. R. Spofford	W. D. Gibson	G. W. Benson
	H. M. Harlow	Lee Mayfield	H. M. Harlow	F. M. Misch
	H. B. Christianson	Franz M. Misch	V. E. Engman	L. R. Morgan
	F. R. Spofford	W. D. Gibson	G. W. Benson	J. A. Jorlett

	1950-1951	1951-1952	1952-1953	1953-1954
President	W. A. Huckstep	Guy E. Martin	F. R. Spofford	Lee Mayfield
1st V.-Pres.	Guy E. Martin	F. R. Spofford	Lee Mayfield	H. M. Harlow
2nd V.-Pres.	F. R. Spofford	Lee Mayfield	H. M. Harlow	J. A. Jorlett
3rd V.-Pres.	Lee Mayfield	H. M. Harlow	J. A. Jorlett	R. R. Gunderson
4th V.-Pres.	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	F. M. Misch	M. H. Dick	W. H. Huffman	M. H. Dick
	L. R. Morgan	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells
	J. A. Jorlett	J. F. Warrenfells	B. M. Stephens	G. Switzer
	M. H. Dick	W. H. Huffman	M. H. Dick	B. M. Stephens
	R. R. Gunderson	L. R. Morgan	J. F. Warrenfells	W. H. Bunge
	J. F. Warrenfells	B. M. Stephens	G. Switzer	E. R. Schlaf

	1954-1955	1955-1956	1956-1957	1957-1958
President	H. M. Harlow	J. A. Jorlett	R. R. Gunderson	W. H. Huffman
1st V.-Pres.	J. A. Jorlett	R. R. Gunderson	W. H. Huffman	M. H. Dick
2nd V.-Pres.	R. R. Gunderson	W. H. Huffman	M. H. Dick	B. M. Stephens
3rd V.-Pres.	W. H. Huffman	M. H. Dick	B. M. Stephens	H. D. Curie
4th V.-Pres.	M. H. Dick	B. M. Stephens	H. D. Curie	
Secretary	Elise LaChance	Elise LaChance	Elise LaChance	Elise LaChance
Treasurer	L. C. Winkelhause	L. C. Winkelhaus	L. C. Winkelhaus	L. C. Winkelhaus
Directors	B. M. Stephens	J. F. Warrenfells	W. H. Bunge	G. W. Benson
	W. H. Bunge	H. D. Curie	E. R. Schlaf	J. M. Lowry
	E. R. Schlaf	J. M. Lowry	G. W. Benson	H. H. Matthews
	J. F. Warrenfells	W. H. Bunge	J. M. Lowry	T. M. von Sprecken
	H. D. Curie	E. R. Schlaf	T. M. von Sprecken	W. H. Bunge
	J. M Lowry	G. W. Benson	H. A. Matthews	E. R. Schlaf

	1958-1959	1959-1960	1960-1961	1961-1962
President	M. H. Dick	B. M. Stephens	H. D. Curie	G. W. Benson
1st V.-Pres.	B. M. Stephens	H. D. Curie	G. W. Benson	J. M. Lowry
2nd V.-Pres.	H. D. Curie	G. W. Benson	J. M. Lowry	E. R. Schlaf
3rd V.-Pres.	G. W. Benson	J. M. Lowry	E. R. Schlaf	H. A. Matthews
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	L. C. Winkelhause	L. C. Winkelhaus	L. C. Winkelhause
Directors	J. M. Lowry	W. H. Bunge	H. A. Matthews	R. C. Baker
	R. C. Baker	E. R. Schlaf	M. J. Hubbard	R. H. Miller
	W. H. Bunge	H. A. Matthews	R. C. Baker	Shirley White
	E. R. Schlaf	M. J. Hubbard	R. H. Miller	H. M. Wilson
	H. A. Matthews	R. C. Baker	Shirley White	R. D. Hellweg
	M. J. Hubbard	R. H. Miller	H. M. Wilson	F. W. Hutcheson

	1962-1963	1963-1964	1964-1965	1965-1966
President	J. M. Lowry	E. R. Schlaf	R. C. Baker	H. M. Wilson
1st V.-Pres.	E. R. Schlaf	R. C. Baker	H. M. Wilson	R. D. Hellweg
2nd V.-Pres.	H. A. Matthews	Shirley White	R. D. Hellweg	J. W. DeValle
3rd V.-Pres.	R. C. Baker	H. M. Wilson	J. W. DeValle	W. F. Armstrong
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	L. C. Winkelhaus	E. F. Snyder	E. F. Snyder	E. F. Snyder
Directors	Shirley White	R. D. Hellweg	W. F. Armstrong	J. A. Goforth
	H. M. Wilson	F. W. Hutcheson	J. S. Ellis	E. R. Simmons
	R. D. Hellweg	W. F. Armstrong	J. A. Goforth	N. D. Bryant
	F. W. Hutcheson	J. W. DeValle	E. R. Simmons	A. R. Dahlberg
	W. F. Armstrong	J. A. Goforth	N. D. Bryant	J. S. Ellis
	J. W. DeValle	E. R. Simmons	A. R. Dahlberg	T. L. Fuller

	1966-1967	1967-1968	1968-1969	1969-1970
President	R. D. Hellweg	J. W. DeValle	W. F. Armstrong	J. A. Goforth
1st V.-Pres.	J. W. DeValle	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg
2nd V.-Pres.	W. F. Armstrong	J. A. Goforth	A. R. Dahlberg	T. L. Fuller
3rd V.-Pres.	J. A. Goforth	A. R. Dahlberg	T. L. Fulle	N. D. Bryant
Secretary	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg	Ruth Weggeberg
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	N. D. Bryant	J. S. Ellis	N. F. Lucas	W. H. Rankin
	A. R. Dahlberg	T. L. Fuller	W. L. Short	E. E. Runde
	H. F. Lucas	R. A. Youngblood	C. E. Wachter	T. A. Reynolds
	J. S. Ellis	H. F. Lucas	A. C. Jones	J. J. Ridgeway
	T. L. Fuller	W. L. Short	W. H. Rankin	J. R. Williams
	R. A. Youngblood	C. E. Wachter	E. E. Runde	J. W. Chambers
	V. D. Raessler	A. C. Jones	T. A. Reynolds	R. E. Frame
	W. L. Short	W. H. Rankin	J. J. Ridgeway	J. C. Hobbs
	C. E. Wachter	E. E. Runde	J. R. Williams	

	1970-1971	1971-1972	1972-1973	1973-1974
President	A. R. Dahlberg	T. L. Fuller	N. D. Bryant	E. E. Runde
1st V.-Pres.	T. L. Fuller	N. D. Bryant	E. E. Runde	J. J. Ridgeway
2nd V.-Pres.	N. D. Bryant	E. E. Runde	J. J. Ridgeway	J. R. Williams
3rd V.-Pres.	E. E. Runde	J. J. Ridgeway	J. R. Williams	W. R. Rankin
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	T. A. Reynolds	J. W. Chambers	R. K. Corbett	D. C. Gould
	J. J. Ridgeway	R. E. Frame	J. R. Iwinski	W. S. Stokely
	J. R. Williams	J. C. Hobbs	J. S. Pritchett	W. C. Sturm
	J. W. Chambers	R. K. Corbett	D. C. Gould	J. W. Davidson
	R. E. Frame	J. R. Iwinsky	W. S. Stokeley	C. A. Hughes
	J. C. Hobbs	J. S. Pritchett	W. C. Sturm	W. R. Hyma
	R. K. Corbett	D. C. Gould	J. W. Davidson	O. C. Denz
	J. R. Iwinsky	W. S. Stokeley	C. A. Hughes	R. C. McMaster
	J. S. Pritchett	W. C. Sturm	W. R. Hyma	W. E. Brakenslek

	1974-1975	1975-1976	1976-1977	1977-1978
President	J. J. Ridgeway	J. R. Williams	W. H. Rankin	J. R. Iwinski
1st V.-Pres.	J. R. Williams	W. H. Rankin	J. R. Iwinski	W. C. Sturm
2nd V.-Pres.	W. H. Rankin	J. C. Hobbs	W. C. Sturm	D. C. Gould
3rd V.-Pres.	J. C. Hobbs	J. R. Iwinski	D. C. Gould	J. W. Chambers
Secretary	Ann Wilson	Ann Wilson	Ann Wilson	Ann Wilson
Treasurer	W. H. Huffman	W. H. Huffman	W. H. Huffman	W. H. Huffman
Directors	J. W. Davidson	W. E. Brakensiek	J. W. Chambers	W. J. Gunkle
	C. A. Hughes	O. C. Denz	M. Noyszewskl	W. E. Halley
	W. R. Hyma	R. C. McMasters	W. J. Gunkle	K. L. Wammell
	W. E. Brakensiek	F. R. Lindsay	W. E. Halley	J. Budzileni
	O. C. Denz	M. Noyszewski	K. L. Wammel	B. J. King
	R. C. McMasters	W. C. Sturm	J. Budzileni	J. G. Robertson
	F. B. Lindsay, Jr.	W. J. Gunkle	B. J. King	O. C. Denz
	M. Noyszewski	W. E. Halley	J. G. Robertson	E. C. Patterson
	Jim Payne	K. L. Wammel		W. S. Stokely

	1978-1979	1979-1980		
President	W. C. Sturm	D. C. Gould		
Sr. V.-Pres.	D. C. Gould	J. W. Chambers		
Jr. V.-Pres.	J. W. Chambers	R. C. McMaster		
Jr. V.-Pres.	R. C. McMaster	W. R. Hyma		
Secretary	Ann Wilson	Ann Wilson		
Treasurer	W. F. Armstrong	W. F. Armstrong		
Directors	J. Budzileni	O. C. Denz		
	B. J. King	W. J. Gunkle		
	J. G. Robertson	W. S. Stokely		
	O. C. Denz	L. D. Green		
	E. C. Patterson	C. M. Russell		
	W. S. Stokely	J. M. Williams		
	L. D. Green	D. A. Bessey		
	C. M. Russell	J. N. Michel		
	J. M. Williams	P. H. Saletnik		

HISTORICAL INFORMATION

List of Annual Conventions

No.	Place of Meeting	Date	Membership
1	St. Louis, Mo.	Sept. 25, 1891	60
2	Cincinnati, Ohio	Oct. 18-19, 1892	112
3	Philadelphia, Pa.	Oct. 17-19, 1893	128
4	Kansas City, Mo.	Oct. 16-18, 1894	115
5	New Orleans, La.	Oct. 15-16, 1895	122
6	Chicago, Ill.	Oct. 20-22, 1896	140
7	Denver, Colo.	Oct. 19-21, 1897	127
8	Richmond, Va.	Oct. 18-19, 1898	148
9	Detroit, Mich.	Oct. 17-19, 1899	148
10	St. Louis, Mo.	Oct. 16-18, 1900	143
11	Atlanta, Ga.	Oct. 15-17, 1901	171
12	Minneapolis, Minn.	Oct. 21-23, 1902	195
13	Quebec, Canada	Oct. 20-22, 1903	223
14	Chicago, Ill.	Oct. 18-20, 1904	293
15	Pittsburgh, Pa.	Oct. 17-19, 1905	313
16	Boston, Mass	Oct. 16-18, 1906	340
17	Milwaukee, Wis.	Oct. 15-17, 1907	341
18	Washington, D. C.	Oct. 20-22, 1908	368
19	Jacksonville, Fla.	Oct. 19-21, 1909	393
20	Denver, Colo.	Oct. 18-20, 1910	428
21	St. Louis, Mo.	Oct. 17-19, 1911	499
22	Baltimore, Md.	Oct. 15-17, 1912	524
23	Montreal, Quebec	Oct. 21-23, 1913	570
24	Los Angeles, Cal.	Oct. 20-22, 1914	586
25	Detroit, Mich.	Oct. 19-21, 1915	665
26	New Orleans. La.	Oct. 17-19, 1916	710
27	Chicago, Ill.	Oct. 16-18, 1917	704
28	Chicago, Ill.	Oct. 15-17, 1918	716
29	Cleveland, Ohio	Oct. 21-23, 1919	776
30	Atlanta, Ga.	Oct. 26-28, 1920	840
31	New York, N. Y.	Oct. 18-20, 1921	850
32	Cincinnati, Ohio	Oct. 17-19, 1922	865
33	Seattle, Wash.	Oct. 16-18, 1923	846
34	Kansas City, Mo.	Oct. 21-23, 1924	837
35	Buffalo, N. Y.	Oct. 20-22, 1925	759
36	Richmond, Va.	Oct. 12-14, 1926	750
37	Minneapolis, Minn.	Oct. 18-20, 1927	754
38	Boston, Mass.	Oct. 23-25, 1928	755
39	New Orleans, La.	Oct. 15-17, 1929	755
40	Louisville, Ky.	Oct. 21-23, 1930	713
41	Chicago, Ill.	Oct. 16-18, 1934	592
42	Chicago, Ill.	Oct. 15-17, 1935	547
43	Chicago, Ill.	Oct. 20-22, 1936	588
44	Chicago, Ill.	Oct. 19-21, 1937	566
45	Chicago, Ill.	Oct. 18-20, 1938	589
46	Chicago, Ill.	Oct. 17-19, 1939	546
47	Chicago, Ill.	Oct. 15-17, 1940	610
48	Chicago, Ill.	Oct. 14-16, 1941	594
49	Chicago, Ill.	Oct. 20-22, 1942	618
50	Chicago, Ill.	Oct. 20-21, 1943	597
51	Chicago, Ill.	Sept. 17-19, 1946	698
52	Chicago, Ill.	Sept. 16-18, 1947	651
53	Chicago, Ill.	Sept. 20-22, 1948	652
54	Chicago, Ill.	Sept. 12-14, 1949	676

No.	Place of Meeting	Date	Membership
55	Chicago, Ill.	Sept. 18-20, 1950	713
56	Chicago, Ill.	Sept. 17-19, 1951	676
57	Chicago, Ill.	Sept. 15-17, 1952	667
58	Chicago, Ill.	Sept. 15-17, 1953	666
59	Chicago, Ill.	Sept. 13-15, 1954	682
60	Chicago, Ill.	Sept. 19-21, 1951	625
61	Chicago, Ill.	Sept. 18-20, 1956	657
62	Chicago, Ill.	Sept. 23-25, 1957	769
63	Chicago, Ill.	Sept. 15-17, 1958	828
64	Chicago, Ill.	Sept. 15-17, 1959	863
65	Chicago, Ill.	Sept. 19-21, 1960	932
66	Chicago, Ill.	Sept. 18-20, 1961	968
67	Chicago, Ill.	Sept. 10-12, 1962	942
68	Chicago, Ill.	Oct. 14-16, 1963	887
69	Chicago, Ill.	Sept. 14-16, 1964	860
70	Chicago, Ill.	Sept. 13-15, 1965	829
71	Chicago, Ill.	Sept. 26-28, 1966	800
72	Chicago, Ill.	Oct. 11-13, 1967	799
73	Chicago, Ill.	Sept. 9-11, 1968	825
74	Chicago, Ill.	Sept. 9-11, 1969	746
75	Chicago, Ill.	Sept. 28-30, 1970	709
76	Chicago, Ill.	Sept. 13-15, 1971	719
77	Chicago, Ill.	Sept. 18-20, 1972	706
78	Chicago, Ill.	Sept. 17-19, 1973	750
79	Chicago, Ill.	Oct. 1- 3, 1974	683
80	Chicago, Ill.	Sept. 15-17, 1975	672
81	Chicago, Ill.	Sept. 13-15, 1976	674
82	Chicago, Ill.	Sept. 26-28, 1977	670
83	Chicago, Ill.	Sept. 18-20, 1978	663
84	Atlanta, Ga.	Oct. 15-18, 1979	642
85	Chicago, Ill.	Sept. 15-17, 1980	652

CONSTITUTION

ARTICLE I.

NAME

Section 1. This association shall be known as the American Railway Bridge & Building Association.

ARTICLE II.

OBJECT

Section 1.** The object of this association shall be the advancement of knowledge pertaining to the design, construction and maintenance of railway bridges, buildings, water service facilities, and other structures, by investigation, reports and discussions.

Section 2. The association shall neither indorse nor recommend any particular devices, trade marks or materials, nor will it be responsible for any opinions expressed in papers, reports or discussion unless the same have received the endorsement of the association in regular session.

ARTICLE III.

MEMBERSHIP

Section 1.* The membership of this association shall be divided into four classes, viz: Members, life members, associate members and honorary members.

Section 2.* A member shall be a person in a position above rank of gang foreman in connection with engineering, construction and maintenance for railway bridges, buildings and water service facilities: or in the employ of a public regulatory body, a professor of engineering or architecture, a technical editor, a government or private timber expert, a consulting engineer, or an engineer in his employ, engaged in the engineering, construction and maintenance of railroad-related facilities or an engineer employed by a technical service or research and development organization, an officer or engineer of an engineering or scientific society or association whose aims and objectives are compatible with the aims and objectives of this association. Any person desirous of becoming a member shall make application upon the form prescribed by the executive committee, setting forth his name, age, residence and practical experience. He shall furnish at least three references to whom he is personally known. Applicants may be voted into membership at any regular executive meeting or by letter ballot of the executive committee, a majority vote being necessary in either instance.

Section 3.** To be eligible for a life membership a member must have belonged to the association for at least 15†† years and in general must have retired from active railway service due to age or physical disability. He shall have all the privileges of membership, except the holding of office, and shall not be required to pay annual dues. The transfer from membership to life membership shall be made in the same manner as the election of members, as prescribed in Section 2, of this Article.

Section 4. Associates shall be responsible persons who are not eligible as members, whose pursuits or attainments qualify them to co-operate with members in the study and development of improved practices in the construction and maintenance of bridges, buildings and water facilities. They shall have all the rights of members except of voting and holding office. They shall be elected in the manner prescribed for members, in Section 2 of this Article.

Section 5. Honorary members shall be chosen from persons who have attained acknowledged eminence in some branch of engineering or railway service. Their number shall be limited to ten. Honorary members shall be proposed by not less than six active members and shall be elected by the unanimous vote of the members present at a regular meeting. They shall have all the rights of members except that of holding office and shall be exempt from the payment of dues.

Section 6. Any member guilty of conduct unbecoming to a railroad officer and a member of this association, or who shall refuse to comply with the rules of this association, shall forfeit his membership on a two-thirds vote of the executive committee.

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*Amended September, 1976.
** Amended September 20, 1948
†† Amended March 10, 1958.

Section 7. Membership shall continue until written resignation is received by the secretary, unless member has been previously expelled, or dropped for non-payment of dues in accordance with Section 1 of Article VII.

Section 8.** Only members shall hold office in this association, and only members and life members shall be entitled to vote in the election of officers.

ARTICLE IV.

OFFICERS

Section 1‡‡. The officers of the Association shall be a President, two Junior Vice Presidents, a Senior Vice President, a Secretary, a Treasurer and nine Directors, who, with the most recent Past President, shall constitute the Executive Committee.

Section 2. The past presidents of this association, previous to the most recent past president, who continue to be members shall be privileged to attend all meetings of the executive committee, at which meetings they shall receive due notice, and be permitted to discuss all questions and to aid said committee by their advice and counsel; but said past presidents shall not have a right to vote, unless called upon to fill a quorum.

Section 3. Vacancies in any office shall be filled for the unexpired term by the executive committee without delay.

ARTICLE V.

EXECUTIVE COMMITTEE

Section 1.** The executive committee shall manage the affairs of the association and shall have full power to control and regulate all matters not otherwise provided for in the constitution and by-laws and shall exercise general supervision over the financial interests of the association, and make all necessary purchases and contracts required to conduct the general business of the association, but shall not have the power to render the association liable for any debt beyond the amount then in the treasury plus accounts receivable and not subject to other prior liabilities. All appropriations for special purposes must be acted upon at a regular meeting of the association.

Section 2. Meetings of the executive committee may be called by a majority of the members of the committee, providing 10 days' notice is given members by mail.

Section 3. Five members of the executive committee shall constitute a quorum for the transaction of business.

ARTICLE VI.

ELECTION OF OFFICERS AND TENURE OF OFFICE

Section 1. Except as otherwise provided the officers shall be elected at the regular annual meeting of the association and the election shall not be postponed except by unanimous consent of the members present at said annual meeting. The election shall be by ballot, a majority of the votes cast being required for election. Any member of the association not in arrears for dues shall be eligible for office, but the president shall not be eligible for re-election.

Section 2‡‡. The President, two Junior Vice Presidents, Secretary, and Treasurer shall hold office for one year and the Directors for three years; three Directors being elected each year. The Senior Vice President shall hold office for one year and ascend to the office of President at the expiration of such service. All officers shall retain their office until their successors are elected and installed. A Director elected for a three-year term shall not be eligible to serve two consecutive terms.

Section 3.† The term of office of the secretary and the treasurer may be terminated at any time by a two-thirds vote of the executive committee. Their compensation shall be fixed by a majority vote of the executive committee.

The secretary shall also serve as secretary of the executive committee.

Section. 4. The secretary and the treasurer shall be required to give bond in an amount to be fixed by the executive committee.

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* Amended October 16, 1941.
† Amended September 21, 1957.
§ Amended September 28, 1966.
‡‡ Amended September 20, 1978

ARTICLE VII.

MEMBERSHIP FEE AND DUES

Section 1.† Every member upon joining this association shall pay to the secretary an entrance fee and dues as prescribed by the executive committee. No member in arrears for annual dues shall be entitled to vote at any election and any member more than one year in arrears, may be stricken from the list of members at the discretion of the executive committee.

Section 2.‡ A person stricken from the list of members because of non-payment of dues, upon written application may be reinstated as a member in his former class without loss of privileges, either upon payment of all back dues (which must accompany applicants) or at the discretion of the executive committee voting in the manner prescribed in Section 2, Article III.

ARTICLE VIII.*

LOCAL SECTIONS

Section 1.** Upon the application of ten or more members of the association residing in the same geographical district, or having offices therein, the executive committee shall organize a local section for that district, to which all members in that district shall be eligible. Such local section shall admit to active membership only members in good standing. It shall hold not less than two meetings each year, and shall be governed by such constitution and by-laws not inconsistent with the constitution of this association as the section membership may adopt and the executive committee approve.

Section 2. The parent association shall not be put under any obligation, either financial or in the matter of policy or opinion, by any local section.

ARTICLE IX.

AMENDMENTS

Section 1. This constitution may be amended at any regular meeting by a two-thirds vote of the members present, provided that notice of the proposed amendment or amendments has been sent to the members at least 30 days previous to said regular meeting.

By-Laws

TIME OF MEETING

1.** The regular meeting of this association shall convene annually during the month of September, the exact date to be fixed by the executive committee.

PLACE OF MEETING

2.** The place of holding the annual convention shall be Chicago, Ill.

3. It shall be within the power of the executive committee to change the location or time of the meeting if it becomes apparent that it is for the best interests of the association.

QUORUM

4. At the regular meeting of the association, 15 or more members shall constitute a quorum.

***DUES

5. The annual dues for the fiscal year ending August 31, and payable in advance, shall be as follows:*

Members, $7.00; Associate Members, $7.00.

DUTIES OF OFFICERS

6.† The president shall have general supervision over the affairs of the association. He shall preside at all meetings of the association and of the executive committee; shall appoint all committees not otherwise provided for, and shall be ex-officio mem-

† Amended October 17, 1940.
* Article adopted 1922.
** Amended September 20, 1948
‡ Amended September 21, 1957.
*** Amended September 15, 1965.

ber of all committees. He shall with the secretary sign all contracts or other written obligations of the association which have been approved by the executive committee. He shall render a detailed report at least three times during the year to the members of the executive committee, showing the financial condition of the association and its activities.

At the annual meeting the president shall present a report containing a statement of the general conditions of the association.

7.‡‡ The Vice-Presidents in order of seniority shall preside at meetings in the absence of the President and discharge his duties in case of a vacancy in his office. The Senior Vice President shall have the senior position of Vice Presidents.

8.† It shall be the duty of the secretary to keep a correct record of the proceedings of all meetings of this association, and of all accounts, between this association and its members; to collect all moneys due the association, and deposit the same in the name of the association. He shall pay all bills when properly certified and approved by the president and the treasurer, and make such reports as may be called for by the executive committee. He shall also perform such other duties as the association may require.

9.‡ The treasurer shall have charge of the funds, check all deposits as made by the secretary, sign all checks after they have been approved by the president, and invest all funds not needed for current expenses as directed by the executive committee. He shall report at each annual meeting on the condition of the finances.

NOMINATING COMMITTEE

10.# After each annual meeting the president shall appoint a committee consisting of five members. Two Past Presidents shall be members of this committee, one of whom shall act as Chairman. No other officers of the Association shall be appointed to this committee. This committee shall prepare a list of names of nominees for officers to be voted on at the next annual convention in accordance with ARTICLE VI of the Constitution, said list to be read at the business session of said convention. Nothing in this section shall be construed to prevent any member making further nominations.

AUDITING COMMITTEE

11.‡ Prior to each annual meeting the president shall appoint a committee of three members, not officers of the association, whose duty it shall be to examine the accounts and vouchers of the secretary and the treasurer and certify as to the correctness of their accounts.

COMMITTEE ON SUBJECTS FOR DISCUSSION

12. After each annual meeting the president shall appoint a committee whose duty it shall be to prepare a list of subjects for investigation to be submitted for approval at the next convention.

COMMITTEE ON INVESTIGATION

13. After the association has adopted the list of subjects for investigation the president for the succeeding year shall appoint the committees who shall prepare the subjects for report and discussion. He may also appoint individual members to prepare reports on special subjects, or to report on any special or particular subject.

PUBLICATION COMMITTEE

14. After each annual meeting the executive committee shall appoint a publication committee consisting of three active members whose duty it shall be to cooperate with the secretary in the issuing of the publications of the association. The assignment of this committee shall be such that at least one member shall have served on the committee during the previous year.

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‡ Adopted October 17, 1940.
# Amended December 4 1950.
† Amended September 20, 1948.
‡ Amended September 21, 1957.
‡‡ Amended September 20, 1978

ORDER OF BUSINESS

15.† Call to order by president.
Opening prayer or invocation.
President's address.
Report of secretary.
Report of treasurer.
Appointment of special committees.
Reports of standing committees and presentation of papers.
Unfinished business.
New business.
Election of officers.
Installation of officers.
Adjournment.

DECISIONS

16. The votes of a majority of the members present shall decide any questions. motion or resolution which shall be brought before the association, unless otherwise provided. Unless specifically provided herein otherwise, all discussions shall be governed by Robert's rules of order.

AMENDMENTS

17.† The By-Laws can be amended by a two-thirds vote of those present at any regularly called executive committee meeting.

---

† Amended September 20, 1948.

DIRECTORY OF MEMBERS

As of Feb. 15, 1981

HONORARY MEMBERS

Benson, G. W.
Curie, H. D.
Dick, M. H.
Dove, R. E.
Gunderson, R. R.
Howard, N. D.
Huffman, W. H.
Jorlett, J. A.
Schlaf, E. R.
Winkelhaus, L. C.

LIFE MEMBERS

Arnold, L. K.
Baker, F. A.
Barsema, M.
Beaver, J. F.
Bell, D. V.
Beringer, M. A.
Bishop, D. B.
Boehling, H. A., Jr.
Bowman, R. M.
Bradfield, R. G.
Buckmaster, W. A.
Bunge, W. H.
Burch, E. E.
Burleson, H. S.
Burpee, C. M.
Camelle, E. J.
Carlson, A. W.
Carter, J. W.
Celander, H. W.
Chamberlain, P.
Christianson, H. B.
Cooper, S. A.
Cross, E. T.
Cummins, C. P.
Davis, H. E.
DeValle, J. W.
Dixon, C. E.
Duchac, J. V.
Eargle, J. M.
Eichenlaub, C. M.
Elliott, C. E.
Enstrom, W. A.
Erskine, J. A.
Forseth, C. E.
Fort, O. E.
Fox, R. L.
Gipson, C. G.
Hawley, I. H.
Hedley, W. J.
Hellweg, R. D.
Hendrix, W. P.
Hickok, B. M.
Hodgkins, E. W.
Hogel, E. C.
Howard, J. G.

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Hubbard, M. J.
Humphreys, R. W.
Hunter, A. L.
Hutcheson, F. W.
Hutcheson, T. B.
Hutcheson, W. A.
Hutto, J. E.
Jackson, T. E.
Jenkins, H. W.
Johnson, A. C.
Johnson, B. O.
Johnson, E. A.
Johnson, H. T.
Jones, W. J.
Kendal, J. T.
Kieckers, E. W.
Kvenberg, S. E.
Leach, A. L.
Linn, G. A.
Little, H. C.
Lokotzke, G. P.
Lowry, J. M.
Lucas, H. F.
Lund, C. V.
Mabry, D. B.
Martens, W. F.
Martin, J. W.
Messman, D. V.
Meyers, B. R.
Moore, I. A.
Moris, R. F.
Myers, E. T.
Myers, R. L.
Oest, W. C.
Ostrom, W. D.
Packard, B. G.
Pahl, W. H., Jr.
Patterson, C. C.
Patterson, C. A.
Patterson, J. M.
Perrier, J. L.
Peterson, N. E.
Presthus, E. J.
Pritchard, B. L.
Prude, G. F.
Raessler, V. D.
Rainey, W. H.
Reger, J. H.
Robinson, G. E.
Rothell, R. D.
Runde, E. E.
Safley, J. R.
Salmon, J. M., Jr.
Sathre, C. O.
Saunders, T. D.
Seley, L. L.
Seltzer, J. W.
Shamblin, R. E.
Short, W. L.
Simonson, E. F.
Sinclair, C. H.
Slagle, G. P.
Smith, H. E.
Smith, J.
Switzer, G.
Tardy, F. E.
Taylor, W. L.
Termunde, W. L.
Tetreault, L. J.
Thatcher, C. H., Jr.
Thelander, P. V.
Throckmorton, W. B.
Tourtellotte, E. B.
Trulove, J. D.
Tucker, N. R.
Tustin, E. O.
Tyckoson, E. G.
Tyler, W. R., Jr.
VanScoyoc, L.
Von Behren, G.
Wachter, C. E.
Wall, R.
Wang, A. B.
Warfield, H., Jr.
Warfield, W. B.
White, S.
Whitehouse, B. M.
Wiemer, H. C.
Williams, C. B.
Williams, D. R.
Williamson, H. M.
Wingerson, C.
Wohlschlaeger, M. A.
Wold, O. R.
Wood, R. E.
Woolford, F. R.
Worden, R. K.
Yaw, D. W.

ALPHABETICAL LIST OF ALL MEMBERS

M Indicates Member
A " Associate Member
L " Life Member
H " Honorary Member

(Figures following name indicate year in which membership became effective)

A

Abbott, E. L. (A'69), Sales Engr., General Railway Signal Co., 2120 Prudential Plaza, Chicago, Ill. 60601

Alexander, R. W. (A'79), Pres., R. W. Alexander Contractors, Inc., P.O. Box 1592, Valdosta, Ga. 31601

Allen, R. F. (M'79), Asst. Mast. Carpenter, S.C.L., Jacksonville, Fla. 32205

Alley, F. T. (M'55), Engr. Br., S.P., Houston, Tex. 77035

Anderson, D. A. (M'80), Supvr. B.&B., D.M.&I.R., Proctor, Minn. 55810

Anderson, H. E. (A'74), Mgr. Opers., Osmose Company, 4546 Tompkins Dr., Madison, Wis. 53716

Anderson, R. D. (A'67), Consultant, Engineers, Inc., 140 Brightwood Ave., Westfield, N.J. 07090

Andrews, D. J. (M'69), Supvr. B.&B., C.&N.W., Green Bay, Wis. 54303

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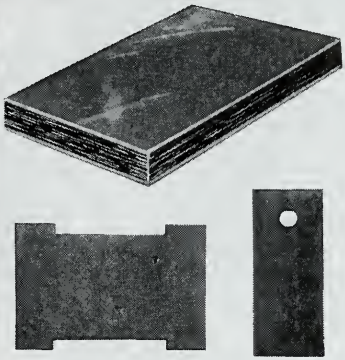
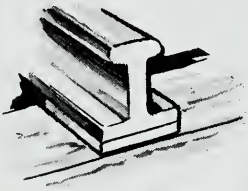
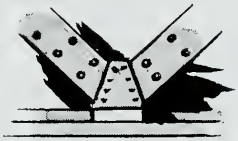


Bridges



Railroads



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Aylward, P. E. (A'76), Sales Supt., Kelly R.R. Construction Co., 6420 Prescott Ave., St. Louis, Mo. 63147

B

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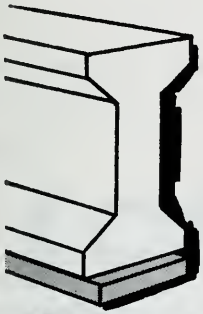

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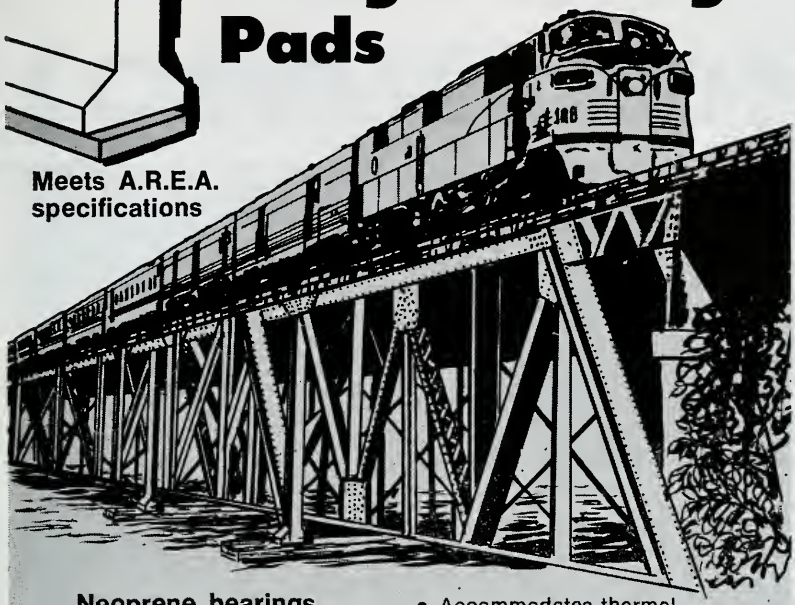

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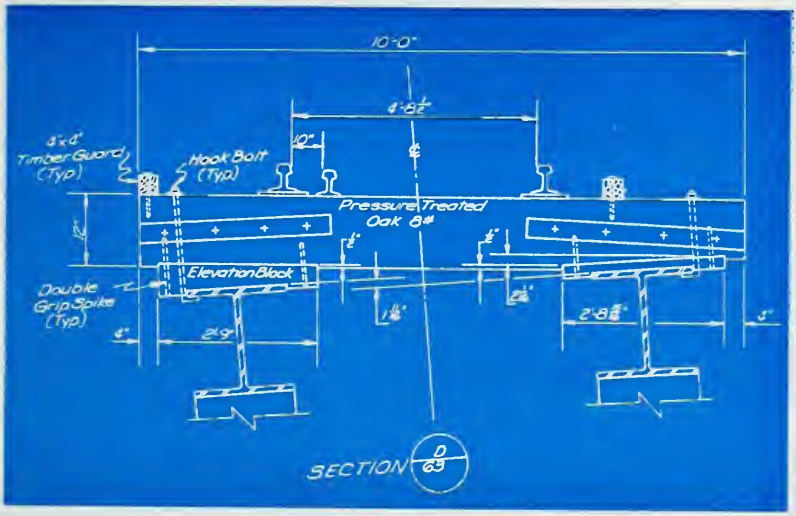

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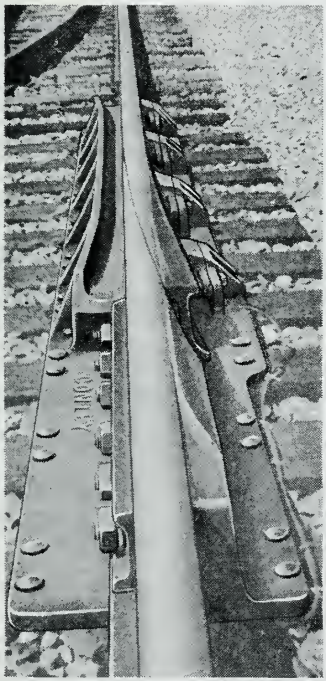

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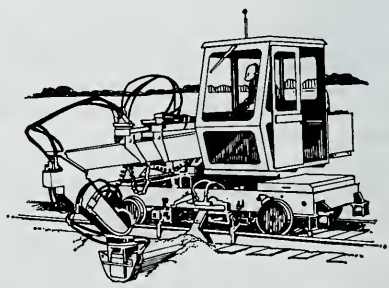
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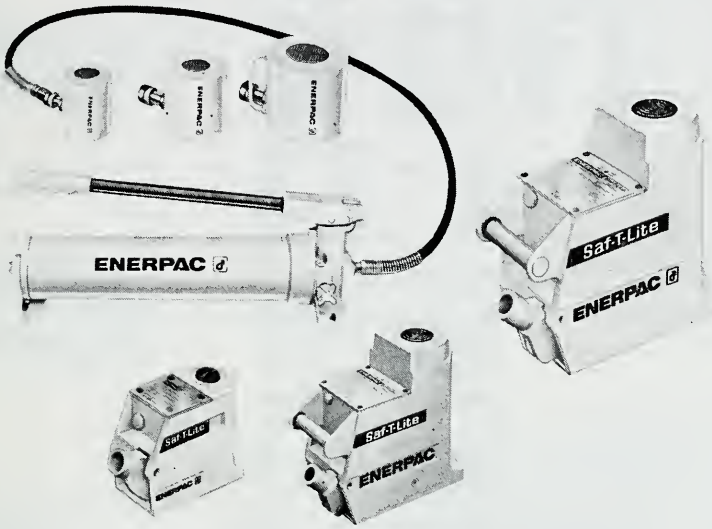

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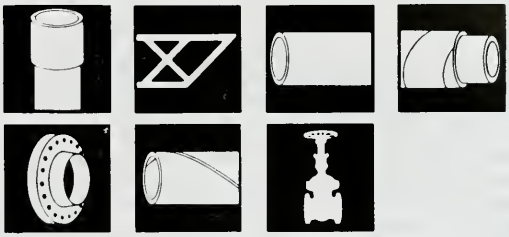

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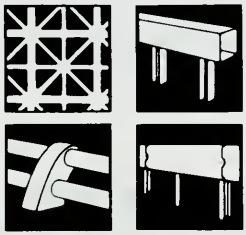

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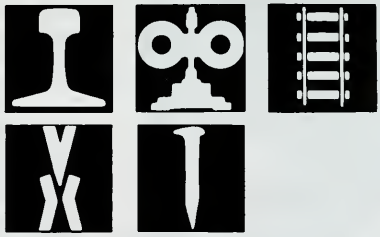

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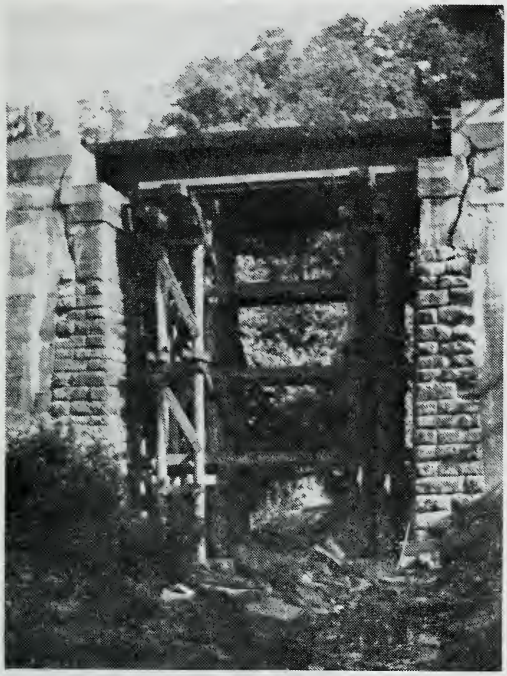

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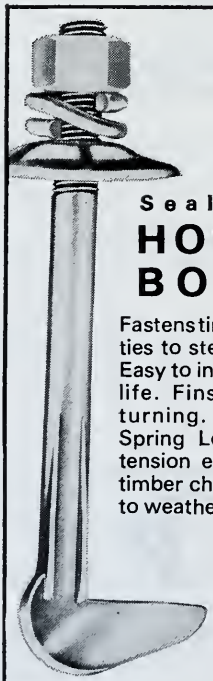

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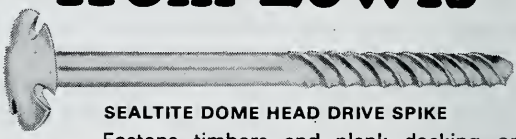

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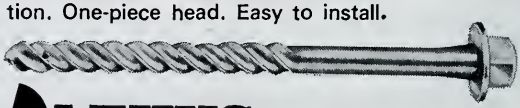

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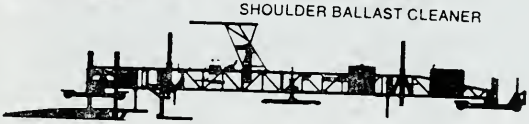

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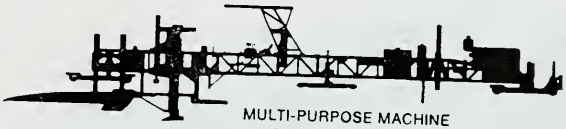

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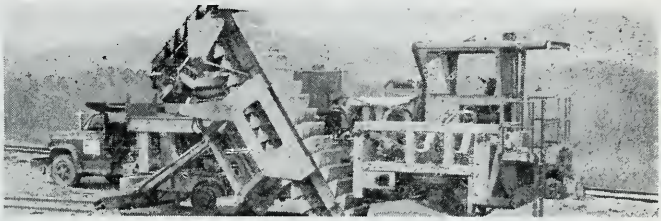

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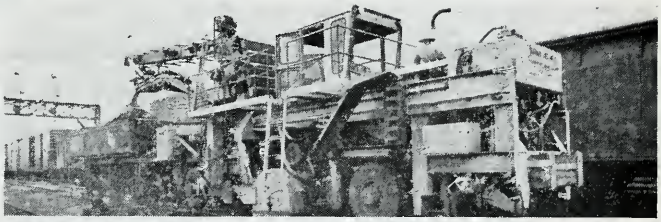

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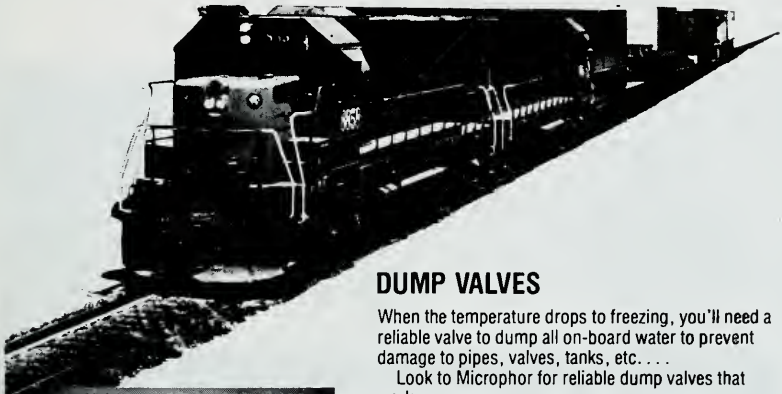

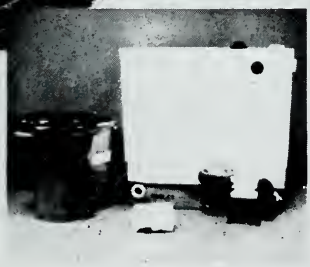

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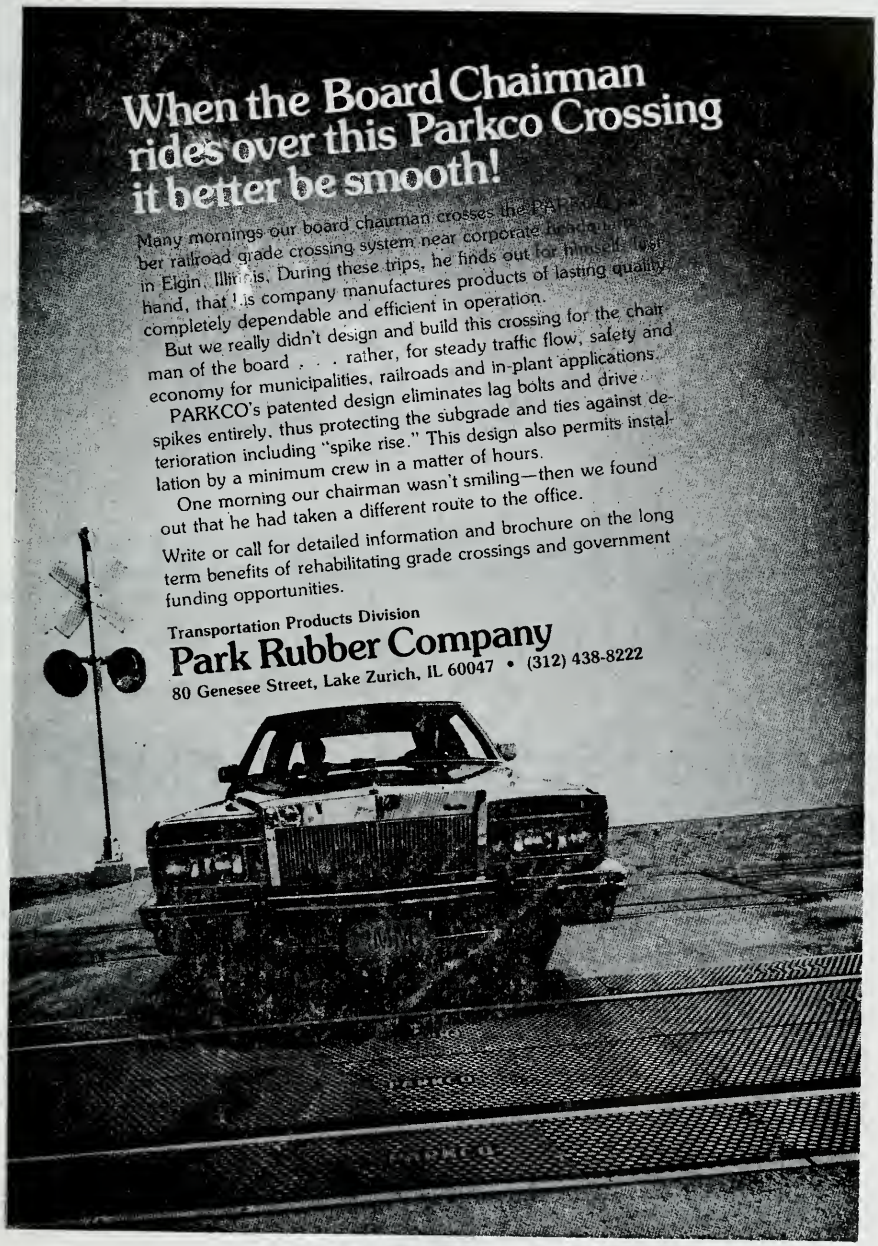

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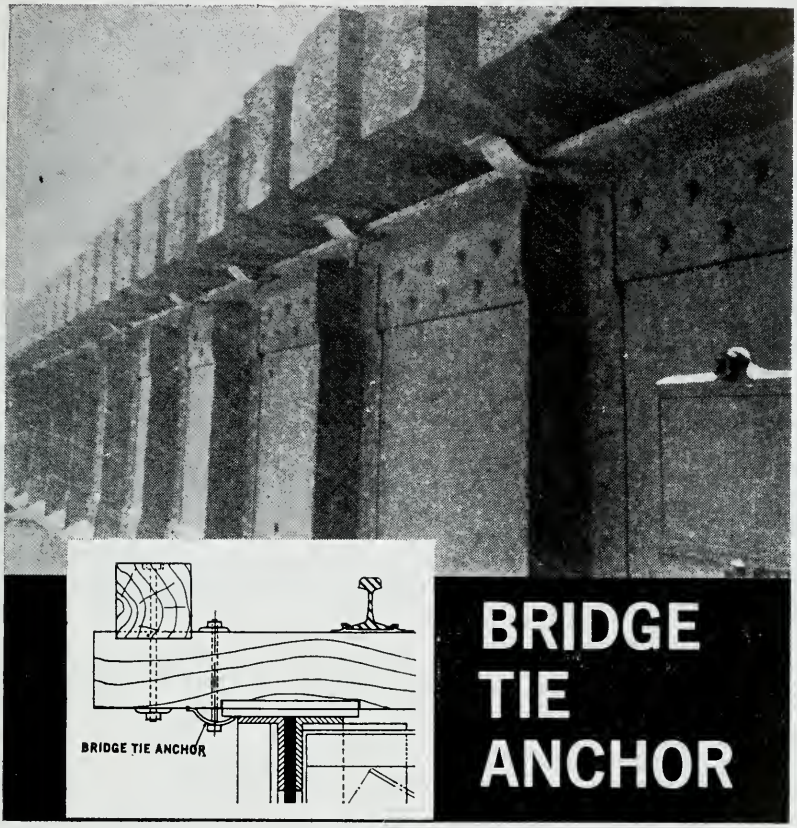

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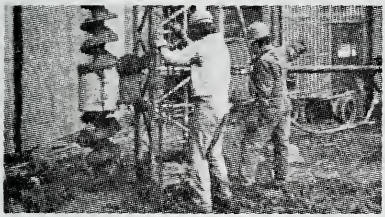

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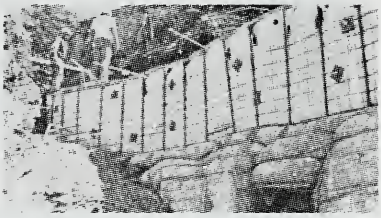

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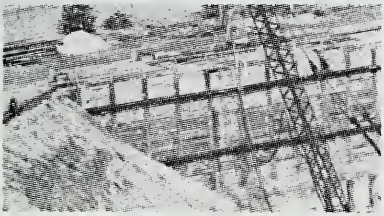

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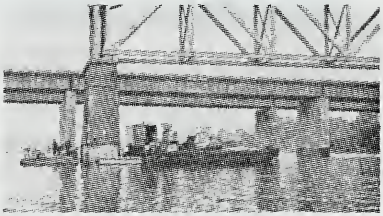

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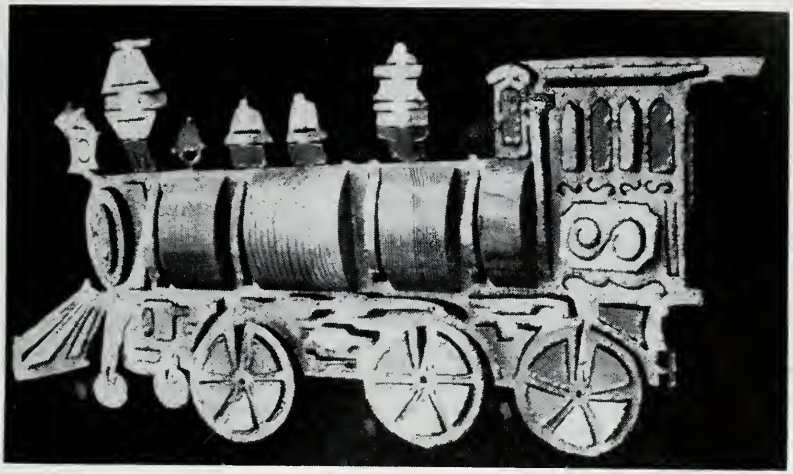

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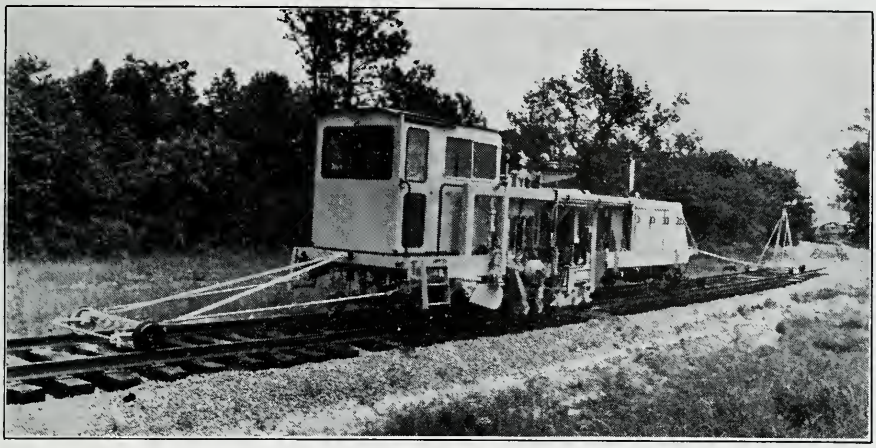

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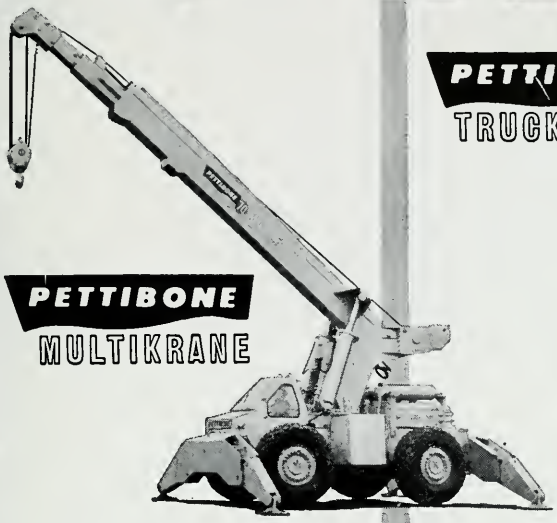

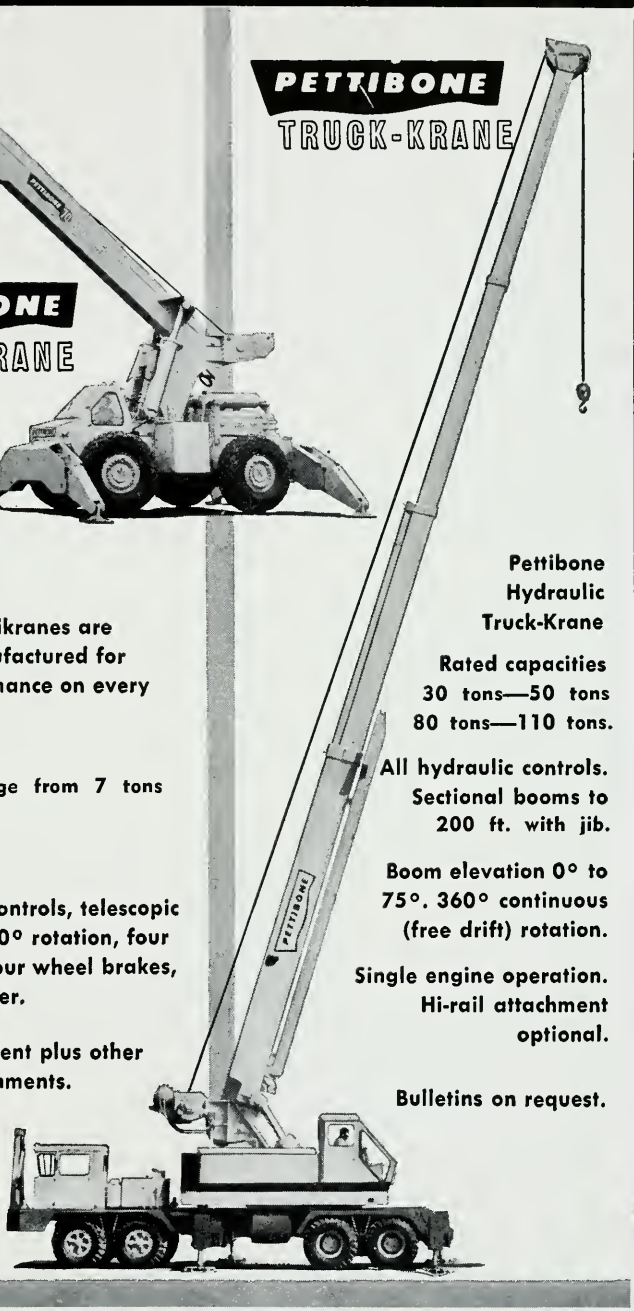

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